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VISIONS

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VOL. XIII. MARCH, 1919. No. 3

A REVIEW OF ASTRONOMY DURING 1918

BY A. F. MILLER

(PRESIDENT'S ADDRESS AT ANNUAL AT-HOME)

AT the commencement of the year 1918 the prospects for astronomical progress did not seem very bright. The world-war which for almost three and a half years had raged with ever-increasing fury, was felt to have reached its crisis, yet none could with any degree of certainty foresee an approaching conclusion, or predict the ultimate result of the terrible conflict. The tide of battle wavered now this way, now that. The appalling sacrifice of life, the ruinous destruction of property, grew greater day by day. The pessimistic stood trembling and aghast; the most optimistic had to admit the extreme gravity of the situation. An awful cloud, black and impenetrable, cast a death-shade over the civilized world; the bravest held their breath for a time, for there were moments when none could say what a day might bring forth. Locked in a life-or-death grapple with a foe, the most savage, the most ruthless, civilization has ever been called on to fight, the Entente and their allies were devoting everything, sacrificing everything, to the superhuman task forced upon them, and which

must be accomplished if they were still to live—the winning of the war.

Under such conditions, small wonder is it that astronomical progress should have been greatly hampered and handicapped. Astronomy and astro-physics are branches of science demanding for their prosecution deep and profound thought; and though elevated to the heavens by their studies, astronomers are, after all, only men. The burden of anxiety which oppressed so many hearts, lay as heavily on theirs. They could hardly be expected to do their best work.

From several sources we learn to what an extent observatory staffs were depleted to meet the call for military engineers, and for scientists competent to work out solutions for the thousands of new problems arising out of war conditions. Above all, astronomers were called on to become instructors in nautical and navigational astronomy, to supply the demand occasioned by the unprecedented growth of the British Navy, and the navies of France and the United States.

At Greenwich and other important English observatories, the workers knew not at what moment death-dealing bombs might be rained down upon them from Zeppelins, whose commanders' main desire was to cause all the havoc and destruction possible. French astronomers in a large part of the territory which had escaped invasion were exposed to even greater perils, for besides the danger from aircraft, every important French city within seventy miles of the German front, was in turn subjected to bombardment by artillery of unprecedented range: and they knew but too well the fate to which a brutal and inhuman enemy had resolved to devote the historic cities of France, and Paris above all. Who has not seen the medal struck by the Hun when he believed the French capital within his grasp? There is depicted a hideous demon figure bestriding a savage steed, triumphantly waving aloft the all-destroying sword and burning brand as he gloats in fiendish joy over the blazing ruins of Paris, the city so dear to the heart of every Frenchman—as it should be to the heart of every *true* man, because of the science, the art, the literature, the refinement,

the advanced thought, expanding from thence for centuries to enlighten and elevate the civilized world. As they listened to the ceaseless roar of the cannonade and felt their instruments quiver when the earth jarred beneath the recoil of giant guns, they must have realized to the full the import of Kipling's stern and solemn warning:

"For all we have and are,
For all our children's fate,
Stand up and meet the war—
The Hun is at the gate."

And should we not ask: What has been the fate of the astronomers in devastated Belgium and the invaded territories of France and other countries? We have heard but little yet, but some news that came has been ominous. The university city of Dorpat taken and retaken by rival revolutionary armies! Batteries of cannon established within 500 metres of the famous Pulkova observatory, which, the director tells us, for five hours was under an intense artillery fire, shells striking the great dome and other buildings. The precious object-glasses had been removed from the instruments, and fortunately the members of the staff and of "the colony" were uninjured, but beyond doubt grave damage was done alike to buildings and equipment. This transpired fifteen months ago; what may have happened since we know not. I have not yet learned what befell the fine old astronomer Dr. F. Terby, of Louvain, when that hapless city was subjected to an appalling fate the mere recital of which made the civilized world shudder. Perhaps he was murdered deliberately, cruelly, like so many of his fellow-citizens. If not destroyed by fire or explosion, that "telescope of eight inches" with which he had achieved so much for science, would doubtless be carried off by the plunderers, and may even now be in the hands of some *Herr Professor*. Such things demand inquiry—and retribution.

What shall be said of German astronomers and scientists? Permit me to quote only a few burning words uttered recently by Raymond Poincaré, President of the Republic of the French, himself a member of a family distinguished for scientific attain-

ment. He said: "Autocratic governments having prepared in the secrecy of their Chancellories and general staff a mad program of universal dominion, at the time fixed by their genius for intrigue, let loose their packs and sounded their horns for the chase; ordering science at the very time when it was beginning to abolish distances, to bring men closer and to make life sweeter, to leave the bright sky toward which it was soaring, and to place itself submissively at the service of the most hideous violence, heretofore undreamed of; lowering the religious idea to the extent of making God the complacent auxiliary of their passions and the accomplice of their crimes."

Speaking for myself, in preparing the pages which are to follow, I sought no aid from the astronomers and scientists of *the enemy*. I can only think of them as the persons who added to the already too great horrors of warfare the fiendish devices of poison gases, flame projectors, disease germs. I can only think of them as perjurers who, to retain the favor of a tyrannical ruler and a military caste as unprincipled as overbearing, lied before Heaven and men by affixing their names to a document written in deliberate contravention of truth, wherein they denied the reality of the horrors and atrocities perpetrated by the ruthless soldiery of Germany in Belgium and in France; or when denial was impossible, with brazen effrontery assured the scientific men to whom their falsehoods were addressed, that the wretched inhabitants of the devastated countries had only received their desert. German scientists may, and probably have, suffered through the war, and doubtless by them as by their fellow-criminals a heavy penalty has still to be paid. I, for one, say with British bluntness: "Serves them right!" These are forever dishonored and discredited. They must come down from the high pedestal to which they had arrogantly exalted themselves. They are no longer the teachers of teachers, no more super-men in science than were their elaborately-trained armies super-men in war, or their ships' crews upon the sea. And the mention of that much-vaunted navy brings to me the thought, that there the demand for naval instructors should not have been very pressing, since the German fleet gener-

ally restricted its navigation to the mine-field protected waters of Heligoland Bight and the Kiel Canal. Doubtless German naval officers, in lieu of nautical astronomy, took a thorough course (under Tirpitz) in Piracy on the High Seas; and as events turned out, they had not much opportunity to display their skill as navigators; for when at last their fleet *did* come out, it was only necessary to shape the compass-course dictated by Beattie's wireless orders, to the place of shameful surrender "without firing a shot", and the haven of ignoble internment at Scapa Flaw.

But to-night I have undertaken to speak to you, not of national immorality, but of astronomical progress during 1918. And it is satisfactory to realize that, in spite of difficulties and obstacles, only a few of which I have mentioned, very valuable work has been accomplished in nearly every branch of the science.

The year 1918 will always be remembered in the annals of astronomy for two remarkable events; the one, predicted long ago, made the subject of refined calculation in every detail, prepared for elaborately, observed and recorded by many trained scientists at practically the identical moments announced beforehand for every phase of the phenomenon; the other, totally unforeseen and unexpected, coming as a surprise to the astronomical world, which it almost startled by its suddenness, yet did not find unprepared, but on the contrary, ready to observe, to record, to investigate every stage of the apparition with instrumental means and with skill not hitherto available.

I am, of course, referring to the total solar eclipse of June 8th, and the "new star", more properly termed Nova Aquilae No. 3, which curiously enough appeared on the same date. I will revert to each of these events in regular course later.

I naturally commence a review of astronomy with our own immediate surroundings—the bodies constituting the solar system, among which, of course, the sun must be accorded the premier place.

Though the actual maximum period of solar activity had passed, sun spots have been quite prevalent during 1918. On almost any clear day an observer, using even a small aperture,

would hardly fail to perceive at least a few sun spots, and from time to time these interesting phenomena were quite numerous, forming zones of groups across the solar disc, individual members of the groups often undergoing remarkable and rapid changes. On several occasions as many as 25 to 30 different spots could be counted, some closely associated, other more widely scattered. The other usual attendants of solar activity, the faculæ and prominences, have also been well in evidence. I regret we have not yet at hand details of the work accomplished and results arrived at during the year at the great observatories where special attention is given to solar physics; however, we need not doubt observations have been carried on assiduously, and important advances achieved, adding much to our knowledge of the wonderful processes whereby the great central source of control and of vivifying energy in our planetary system fulfils the all-important duties devolving upon him. I may just remind you that radial motion, as well as rotation, has been proven to exist in sun spots. In connection with solar activity, I may be permitted to mention the frequency of auroral displays, sometimes of remarkable brightness. It is to be hoped that the study of these interesting phenomena will be greatly assisted by the help of photography, particularly when by the use of extremely rapid plates only instantaneous exposures will be necessary.

It seems quite proper at this point to give a (necessarily) brief account of the total solar eclipse of June 8th, to which, as one of the great astronomical events of the year, I already made reference.

As you are probably aware, on that date the apex of the moon's long conical shadow (the cause of all total eclipses of the sun) touched the earth's surface first at a point in the Pacific Ocean south of Japan and travelled north-easterly, passing southward of Alaska, reaching the North American Continent at an unimportant town called Aberdeen, in the State of Washington, whence, at tremendous speed, it swept diagonally across the whole wide expanse of the United States to the peninsula of Florida, in the brief space of only forty-seven minutes.

This important event, long foreseen and made a subject for exact prediction in every detail, occurring as it did at the most favorable time of the year, in the central zone of a great country deservedly noted for its high stage of scientific attainment, especially in all branches of astronomy, naturally aroused the deepest interest, and was prepared for with the utmost care. Every condition likely to facilitate successful observational results was considered in full detail; every variety of instrumental requirement was duly provided. Owing to war conditions in Europe, the astronomers of the old world found themselves debarred from any share in the work, but this loss to science was compensated by the assiduity with which their confrères in the United States made ready to carry out successfully observations of the eclipse phenomena in every phase.

Time will permit me to speak only in the briefest manner of the thoroughness with which the eclipse campaign was arranged. The positions finally selected for the expeditions were located along the path of totality at points where to convenience of access was joined probability of an unclouded sky. They were chiefly in Washington, Oregon, Wyoming, Colorado and Kansas. The City of Denver, possessing a regular observatory of the first class, was situated directly in the shadow-path, from which circumstance much was hoped (hopes unfortunately frustrated by clouds). The observers, though nearly all skilful astronomers, nevertheless underwent preparatory training in every detail of the special work they were to perform.

The auspicious day arrived, bringing to each station the brief but all-important moments of *totality*. At many places clouds threatened to render abortive all the well-planned arrangements of the anxious watchers. Fortunately at most locations the cloud-curtains drew aside just in time to permit accomplishment of all that was vitally important. While more ample success would undoubtedly have been achieved had the observers been favored with cloudless skies, results of the most interesting character and of very high scientific value rewarded the care and assiduity so freely accorded by the men and women of science, who, in most

cases, had journeyed from afar to execute previously planned details in a great and comprehensive design.

Of the observational methods employed time forbids me to speak, and compels me also to recount only in the briefest way what I judge to be most important among a host of interesting and extremely valuable results.

I should explain that at present the chief subjects for investigation during a total solar eclipse are: the nature, composition, and general structure of the *corona*, that pearly, luminous appendage which bursts into view around the eclipsed sun during the brief time the moon's shadow cuts off the solar light from our atmosphere. True, then there also appears the *chromosphere*, an inner zone of glowing crimson gases lying immediately over the *photosphere*, the brilliant white surface whence comes our sunlight. And there are also the *prominences*, marvellous crimson flame-jets, often towering many thousands of miles above the chromospheric stratum. However, as these last-named features can be spectroscopically seen and photographed on any clear day without waiting for an eclipse, the corona, which so far has refused to depict itself except during totality, comes in for chief attention. Incidentally I should mention the *reversing layer*, the thin stratum of metallic vapors underlying the chromosphere, wherein originate most of the familiar dark lines in the solar spectrum. Latterly, however, means have been devised for photographing this interesting region more at leisure than during the instants before and after totality, when, by previously known methods, it could only be observed. Thus, as already pointed out, the corona is the chief objective of astronomers' attacks; and to photograph it with as much detail as possible, as also to record photographically the characteristic lines of its spectrum, is what is chiefly desired.

I wish I could fully describe to you all the admirable work accomplished on June 8th, spite of trouble with clouds. But I can only summarize in a very brief way a few of the more striking results. It must suffice to say that plates taken with the larger type of photo-telescopes show long coronal jets extending out

beyond the sun's limit to at least three solar diameters, or about 12,000,000 km. Some plates record strange curved rays resembling the petals of a flower. A skilled observer who watched the corona visually, tells us its color was pale green, and its structure like the petals of a lily. He believes this last-named appearance is due to crossing currents in the corona. He counted seven of these leaf-like forms, each towering above the sun for several millions of miles.

Five bright coronal lines were recorded by the spectrographs, and their wave lengths accurately determined later. These are as follows: 5,303, 4,231, 4,086, 3,987, 3,601.

Other fainter lines have been perceived on the plates, but not with sufficient clearness to admit of measurement. It was further proven that the corona also gives a continuous spectrum in which the solar dark lines do not appear, thus demonstrating that it is self-luminous and does not shine by reflecting sunlight. The bright lines above mentioned are not coincident with those of any element or substance known to us at present. However, we may expect that with the accurate determinations of wave-length now available, identification with some possibly new element, or perhaps *constituent* of one of our present elementary or simple bodies, should be only a matter of time.

I regret it is not possible to speak of a great many minor observations, all interesting and valuable in their way. I need hardly remind you that Dr. Chant, a past-president of the Society, and Editor-in-Chief of its JOURNAL, was good enough to undertake the long journey to Matheson, Colorado, where he successfully photographed the corona, and also made some observations as to polarization of the coronal light. As we were favored with an account of his work after his return, this brief mention of it must suffice now.

Attention was given to the investigation of what are termed the *shadow bands*, and even the crescent-shaped solar images formed by the light passing through apertures between the leaves of trees were watched for and photographed. Beyond doubt the eclipse observers accomplished excellent work, and their efforts

will prove to have greatly extended our knowledge in the vast domain of solar physics.

Now, leaving the sun, I will speak briefly of work accomplished in the line of planetary study. All the important planets of our system came into positions favorable for observation during 1918, and some were presented under exceptionally advantageous conditions.

I will not detain you with any account of observations of the two inner planets, Mercury and Venus; and indeed I have failed to meet with reports of any new or valuable work done in that connection. I therefore pass on to speak of Mars, which for many reasons may be regarded as the most interesting member of our system. As you doubtless know, the planet Mars comes into opposition at intervals of a little more than two years; consequently we see it under conditions favoring observation of its surface marking every alternate year. Its 1918 opposition occurred about the middle of March last, and though our distance from it at that epoch was quite considerable and consequently its angular diameter small (about 15″), its north declination was a compensation, and the most interesting hemisphere, the northern, was turned earthward during its spring and summer seasons. Our atmospheric conditions also seem to have been generally good, consequently numerous observations were secured and we are being favored with reproductions of many accurate and carefully-made drawings which show beyond question changes evidently due to seasonal succession and climatic conditions. Interesting as are these results, I cannot dwell upon them. I must, however, point out that the reality of those very singular surface markings, often strangely resembling geometrical figures, the existence of which only a few years ago was doubted, and even bluntly denied, is now conceded on all hands, and has been made the subject for several explanatory theories. The presence of water on Mars, in spite of the low temperature theoretically prevailing at its surface, is being more and more widely admitted as alone capable of explaining many of the observed phenomena. Indeed, Professor W. H. Pickering, who, next to the lamented late Percival Lowell,

has long been the most assiduous student of the Martian features, among American astronomers, constantly speaks of "marshes", "flooded areas", "snowstorms" and "hoar frosts", not to mention "clouds" and "fogs", and explains changes of color in the "deserts" as due to the thawing of frozen surface-soil. He has further recently advanced a hypothesis which assumes a meteorological origin for the so-called *canals,* which he believes are effects produced by prevailing rapid winds accompanied by rainfalls. A host of other interesting observations might be cited, did our time allow. While anxious to shun invidious comparisons, I must say that in my own opinion the admirable designs we owe to the skill and patience of Professor Mentore Maggini, of Florence, made during the recent opposition, are the most realistic and excellent I have met with hitherto. So admirably and faithfully has this observer depicted the Martian surface details that anyone familiar with the telescopic appearance of the planet will instantly recognize each particular region and admit the fidelity with which it has been portrayed. Pickering, who is giving careful consideration to observational work done by several amateurs, lays stress on what he recognizes as a demonstrated fact, that for Martian study a very large aperture is not only unnecessary, but may even be a disadvantage. In my own humble way, I have tried to emphasize the utility of small telescopes for that particular work. I trust that at the next opposition of Mars all our members who are possessors of telescopes will not fail to give at least some measure of attention to the study of our most interesting planetary neighbor.

While much might be said in connection with observations of the great exterior planets, Jupiter and Saturn, I will confine my review to pointing out that the visible surfaces of both these bodies evidently consist of zones which have different rotational rates. This fact has not been so fully demonstrated in the case of Saturn as in that of the great Jovian planet; however, differences in the Saturnian rotation period as determined by several good observers can only be explained on that supposition. I believe the unique observation made in 1917 by Messrs. Ainsley and Knight, who saw

an occultation of a sixth magnitude star by the outer ring of Saturn, *the star remaining visible, though reduced in light, while behind the ring,* has not since been duplicated. Doubtless during the several months when it is well placed for observation, occultations of stars by Saturn occur from time to time, and might well be made the subject of watching by amateur observers.

Spectrographic observations of Jupiter and Saturn, while showing several absorption bands, have failed to demonstrate the identity of any of these with bands due to water vapor.

The results of planetary photography are becoming more satisfactory, and we may not unreasonably indulge in the hope that ere long such greatly improved photographs of Mars, Jupiter and Saturn will be secured as will admit of their profitable study under considerable magnification.

Before leaving the solar system, we may note that only a few small telescopic comets appeared during 1918.

I referred to the appearance of a conspicuous Nova in the constellation of Aquila, as one of the two most noteworthy astronomical events of the year. I already mentioned that by a curious, though, of course, entirely fortuitous, coincidence, it was first seen (at least by astronomers in America) on the evening of June 8th, the day on which occurred the total solar eclipse. Several persons in England, France, and other European countries claim to have seen it earlier, some saying June 6th, others June 7th. However, on a photographic plate of that region of the sky taken at Harvard Observatory on the latter date, it appears as a small star of only the sixth magnitude; so the claims just mentioned could only be reconciled with the undeniable photographic evidence by assuming that the Nova flashed out briefly and suddenly declined, which would be quite an abnormal and previously unheard of occurrence. However, on June 8th it had increased in brightness enormously, 10,000 times, considerably exceeding the first magnitude, being, in fact, the brightest Nova since Kepler's famous star. Its color was at first an intense bluish-white, but as it declined in lustre it became yellow, ruddy, red, and at last dull greenish white. The falling off in brightness was at first very rapid, but afterwards

became more gradual, and was marked by fluctuations of irregular periods. Its spectrum, which during the first 36 hours was that of a type B star, then developed a series of bright lines and bright bands, associated with dark absorption bands on their more-refrangible edges. In this respect the spectrum was similar in character to those of the two previous bright novæ (in Auriga and Perseus). The chief bright lines in the visual region were identical with those of hydrogen and helium; the bright bands were similar to those occurring in the spectra of gaseous nebulæ. Various changes of color, and in the spectrum, were the accompaniments of the star's decline. On November 25th, the last date on which I was able to observe it, the Nova had fallen below the seventh magnitude, and its spectrum was that of a gaseous nebula. Considerable space in the JOURNAL having been devoted to observations of this wonderful object, particularly as regards its light-changes and its spectrum, I will not dwell upon the subject further, beyond pointing out that, though *novae* are by no means infrequent, Nova Aquilae No. 3 was one of the brighest ever seen. Only twelve novae of the first magnitude (or brighter) have been recorded in the annals of astronomy, going back more than two thousand years.

Nova Aquilae is only one of *at least* seven novae observed during 1918. One was discovered in the constellation Unicorn; five others were noticed in the great Andromeda nebula. They were all very small objects.

The most valuable astronomical achievements of the year 1918 have undoubtedly been those relating to the sidereal universe. In general, the published expositions of these elaborate and profound investigations are too technical to be popularly explained, therefore I can only touch on them in a cursory way. Though we have long ceased to apply the term "fixed stars" to the stellar constituents of the constellations which adorn the nocturnal sky, yet less than forty years ago, while great motions, at tremendous velocities, were known to prevail among the stars, the general assumption was, that these motions were taking place in all and every direction without apparent regularity or compliance with

any clearly defined law. But more careful study, and investigation on broader lines, are demonstrating what has been aptly termed *star streaming*, by which is meant that groups of stars, often distinguished by resemblance of nature and constitution, are also endowed with similarity of motion—are, in short, traversing interstellar space in streams, much as currents move through the ocean. And evidence which is accumulating tends to show that all the stars associated with the galaxy (of which our sun is one) are members of some one or another of these star streams, which are moving in curved orbits in a general way, conforming to the direction of the galactic plane, having possibly their foci at its gravitational centre.

To the rapid advances towards what we may fairly call perfection, which are being made in the line of stellar photography, we are indebted for such discoveries as the foregoing. I may instance a quite unexpected and very interesting case to point. I refer to the discovery of a star nearer to our system than α Centauri, till then regarded as the closest stellar neighbor of our sun. An 11th magnitude star in the constellation of the Centaur attracted the attention of Dr. Innes, director of the Johannesburg Observatory, by reason of its large proper motion (which he detected by an ingenious method of simultaneously viewing two photographs of precisely the same region taken at different dates), and he was thus induced to investigate its parallax. In conjunction with Voûte of the Cape Observatory, he has been able to deduce for the star a parallax of 0″.78, that of α Centauri being 0″.76. Its proper motion, in amount and in direction, is almost the same as that of the great star of the Centaur, from which it is distant 2° 13′. But whereas α Centauri is of the first magnitude, *Proxima Centauri*, as it has been provisionally termed, is only of the eleventh magnitude, *or* 20,000 *times less bright*. It is judged to be the least luminous star known to us at present, being only one-sixth as bright as Barnard's star in Ophiuchus. Its faintness and its red color suggest that it may be approaching a stage at which a star ceases to be luminous.

I would gladly endeavor, did time permit, to speak more fully

of our indebtedness to celestial photography for other wonderful advances in astronomical discovery and enlarged conception of the universe. By that means we now are in possession of absolutely accurate charts of the star places for thirty years past. And latterly photographic charting has been so extended that practically all the stars in the heavens are, as it were, made to answer a roll-call each night. I have just spoken of Nova Aquilae 3, and told you that, by means of a plate taken at Harvard Observatory, it was proven that on June 7th a star of only the 6th magnitude existed in the exact position occupied by the Nova, 10,000 times brighter, on June 8th. Other plates have carried back its history as far as 1888, demonstrating that during the interval it had been simply a small variable star, fluctuating between the 11th and the 6th magnitudes. Proof is indeed needless of the immense scientific value of such records as these, available as they will be for all time as bases for the detection of stellar proper motions, variations, new stars, missing stars, and other changes which could never by any other means become known. In the investigation of star parallaxes, photography has attained, and is holding, the place of paramount importance, with the result that our tables of stellar distances, and the corresponding advancement of our conception as to the vastness of the sidereal distances and the extent of the universe have been enlarged manyfold.

Photography in its application to stellar spectra has quite kept abreast with the work done in the lines of which I have just spoken. Greatly enlarged and improved star spectrographs are securing permanent records of the spectra of stars so faint that until recently systematic investigation of these was impracticable. Naturally the careful measurement and minute study of such great numbers of plates demand much time. However, new facts are being brought to light each year, and the outlook for great results in the near future is very hopeful. Undoubtedly mysteries of the most profound character, probably of vital importance, await decipherment in the hieroglyphical lines and bands inscribed on those seemingly dull plates by the stars' own messages sent to us across vast gulfs of space, which the rapid light-waves require

thousands of years to traverse. While the latest investigations all tend to enlarge those distances, already vast beyond comprehension, each year some new key unlocks a previously inscrutable enigma. Progress, if slow, is continuous. Our knowledge grows from more to more, though we can never know *all*.

I cannot leave subjects of such absorbing interest without some reference to a method of research as original as it is novel, which allies the seemingly diverse branches of stellar distances and stellar spectrography. I refer to what is termed *spectroscopic parallax*, which, though only brought to our knowledge within the last couple of years, would seem already to be yielding results as surprising as unexpected. The principle on which Professor Adams and his associates at Mount Wilson are working, rests on assumptions admittedly empirical; however, the agreement between the results arrived at by this method, and those based on the more orthodox trigonometrical determinations of parallax, is very remarkable. And since the spectroscopic method offers a speedy way of approximately learning the parallax of a great many stars, which otherwise could only be arrived at by much labor and after considerable delay, it has been heartily welcomed by astronomical investigators everywhere, the expectation being that as the method is extended its utility will become more evident, and its accuracy more fully established. I feel it is well within the scope of my remarks to-night to include a few explanatory words as to the principle enunciated by Professor Adams, and I cannot do so more concisely than by quoting verbatim an explanation from the pen of that well-known astronomical writer, Mr. H. P. Hollis. He says:—

"Two stars of the same spectral type, but which differ greatly in size, mass, and depth of atmosphere, also differ greatly in absolute luminosity. That is to say—if they were at equal distances from us they would be of very different magnitudes. There is probably in two such stars some gas or component to which corresponds a spectrum line peculiarly sensitive to differences in the above physical conditions, whose appearance will be different in stars of different absolute luminosity, even though these two stars

are of the same spectral type. Hence empirical curves can be constructed connecting line-intensity with absolute magnitude, which can be calibrated as to absolute magnitude of stars which show the chosen spectrum line, and whose parallax has been determined geometrically."

Investigations as to the parallax of nebulae, particularly the small telescopic objects known as spiral nebulae, indicate in the most emphatic way their extreme remoteness. Far from being mere small accumulations of shining matter scattered here and there among the general star-dust of the Milky Way, as was the view generally accepted after Huggins had demonstrated the gaseous nature of some nebular masses, they unquestionably are located at distances of inconceivable vastness from our immediate universe; that is, the galaxy and the stars associated with it. To be seen at all, these nebulae, whatever their nature, must be of enormous dimensions, many in all likelihood much larger than the galaxy itself. Spectroscopic proof has also been obtained of their motions in the line of sight, generally at hitherto unheard of velocities. One spiral system investigated by Slipher at the Lowell Observatory is found to possess a radial motion of 1100 km. per second, while it simultaneously is endowed with a rotational motion of 300 km. per second, which, Dr. Slipher tells us, "is winding it up like a spring."

Many of the seemingly small star clusters familiar to all users of telescopes are, like the nebulae, so extremely remote as to be in reality universes of stars, of dimensions comparable to, or exceeding, those of the galactic universe with which our system is associated. . . .

In concluding, the President referred to the excellent work being done at the Dominion Observatory, Ottawa, with an account of which Dr. Klotz, the director, had recently favored the Society. He also voiced the satisfaction which Canadian astronomers are feeling because of the completion and successful placing in position of the great speculum of the giant reflecting telescope at Victoria, which fortunately was ready for use just at the time the Nova in Aquila appeared, enabling Dr. Plaskett to secure excellent plates of the spectrum of this interesting object.

ANDREW ELVINS (1823-1918)

By C. A. Chant

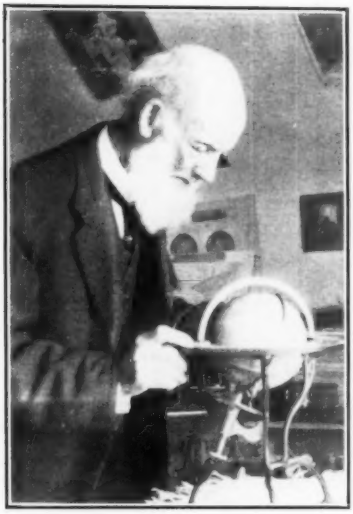
RECENTLY there passed out from among us one who, though little known to the general public, had, for two generations, been regarded with respect bordering on reverence by a circle of scientific friends in Toronto. The story of his life is very simple, but full of interest.

I.

Andrew Elvins was born at Polgooth, a small village near the market town of St. Austell, in Cornwall, England, on May 4, 1823. Not far away are the ancient mines which are supposed to have furnished tin to the Phoenicians perhaps a thousand years before the Christian era. His father, Richard Elvins, and his mother, Mary Johns, and their forefathers were Cornish people. Richard Elvins was a tin miner, but he also carried on a grocery business during Andrew's early years. Both of the parents were inclined to literature, and the father, a religious man of the Methodist stamp, published a book of poems of a religious tendency. Neither possessed the least taste for science.

Andrew's early opportunities for education were very limited. The schools were conducted by private individuals, and at the age of ten he left and went into the mine with his father, his task being to separate the tin-bearing from the other rocks. After two years at this work he left and became a bound apprentice to James Drew, a tailor in a neighboring village. During his apprenticeship he attended night-school, learning the ordinary branches. He had an aggressive mind, and during this period often wandered over his native hills, examining the rocks and minerals, always anxious to find out something new. When about fourteen he read with much interest Pinnock's books of questions and answers in geo-

PLATE I.



1910

1872

ANDREW ELVINS

PLATE II.

ANDREW ELVINS, 1894

graphy. About a year later he discovered in a small lending library connected with the school Sir John Herschel's Outlines of Astronomy, and from it learned of many wonders of which he had previously been unaware. Herschel's explanation of the precession of the equinoxes, Mr. Elvins states, was an important factor in his early education. He used to make sketches of the constellations, not knowing their names, and on recognizing them afterwards, with the aid of Chambers's Encyclopedia, he was greatly pleased and was given an impulse towards the study of astronomy. With the first three shillings which he possessed he purchased a small terrestrial globe. At home there were some books of poems—Cowper, Pope and others—and the Methodist Magazine, published at St. Austell, came in periodically. Mr. Elvins remembered the accession of William IV. and recalled the coronation songs about Queen Adelaide. In the world of politics the names of Wellington, Cobden, Russell, John Bright and others were familiar to him.

When Andrew was about sixteen years of age the son-in-law of his master emigrated to America, leaving his wife and child at home. He was a student and an intelligent man and his books were placed in the bedroom used by Andrew, who was given access to them. In the collection was Chambers's Encyclopedia, which proved a treasure-house of information, and to it he owed more than to all other books put together at that time.

Through his parentage he was naturally interested in religious matters, and he gave much thought to religious problems. By the Bible Christians he was urged into public speaking and, though only seventeen years of age, his name was placed on the regular printed list of men and appointments. He relates that on one occasion he was sent to a place called Goran Haven, and his text was, "What shall the end be of those who obey not the gospel of God?" He knew what the Scriptures had to say on the subject and was also well acquainted with Milton's poems, from which he quoted largely, more largely indeed than from the Bible. He aimed to terrify the people. On coming down from the pulpit he was met by a gentleman, who invited him home to dinner, and

having walked twelve miles, the youthful preacher gladly accepted. His friend was Mr. Charles Peach. He was an excise-man, appointed by the Government for that port, his chief business being to watch for smugglers bringing in brandy and wines from France. He treated the young man with kindness and after dinner took him into an adjoining room and showed him a cabinet containing geological specimens. Mr. Peach was well known as a naturalist and geologist. Indeed, his scientific attainments had attracted the attention of Sir Roderick Murchison, who recommended him for the Government service. The fossils which he had collected, some of them being polished and very beautiful, amazed and fascinated Mr. Elvins. Mr. Peach sometimes lectured, with great success, the last occasion when Mr. Elvins heard him being at Liskeard, after which our Northern Ontario town is named. This visit to Mr. Peach's home made a deep impression on Mr. Elvins. He received a new impetus in his scientific studies; and afterwards, when he learned that Mr. Peach was a Unitarian, his admiration was doubled for the man who could receive one so kindly after he had roundly denounced his religious views.

Mr. Elvins finished his apprenticeship at nineteen and commenced business for himself at Liskeard, but after about two years he considered going to London in order to improve his financial condition. Among the prominent Bible Christians at this time were Paul Robins,[1] William Hooper and Henry Ebbott. The last named was the minister on the Liskeard circuit, and he, on learning that Mr. Elvins was about to leave, proposed that they two go to America. They set out together in 1844. The voyage took six weeks of sailing, and while on the Atlantic Mr. Elvins became of age. There were forty passengers and the trip was fairly pleasant. Though the vessel came out for lumber, its berths were comfortable. Quebec was reached at daybreak, and though all were filled with admiration of the landscape, they were glad to put their feet on the solid earth and have a respite from salted

[1]One of Mr. Robins's sons, Sampson Paul Robins, taught in several schools in Ontario and was for many years principal of the McGill Normal School, Montreal.

pork. Proceeding westward, Mr. Elvins and his party went to By-town (Ottawa), and thence by Rideau Canal to Kingston. On the way much interest was taken in the many beautiful specimens of rocks and minerals found in the localities through which the canal is built.

With some others, Mr. Elvins at once went on to Cobourg. The first house in America in which he slept was in this town, and in it at that time he met the young woman, Alice Rundell, who afterwards became his wife. For two years he was in the employment of a Scotchman named David Ross, in whose house he lived and of whose family he always retained pleasant memories. During his spare hours he took walks, studying the geology of the neighborhood, and he soon found out that he was in a formation which was one of the branches of the Lower Silurian, known as the Trenton limestone. In the rocks of Cornwall fossils are very rare, but while walking out on the very first Sunday after his arrival here he came across a fossil which he had often seen pictured, but which he had never met,—the trilobite, Isotelus gigas, de Kay. In a place which was dry then, but which every spring was covered with water, he found the fossil embedded in the top of one of the rocks. On relating the incident to the present writer over sixty years later, Mr. Elvins stated that he experienced then a thrill of pleasure such as he never expected to feel again. He found the Cobourg limestones abounding in trilobites of different kinds, in fossil shells of every variety, in corals and other interesting objects. Near the lake there was a quarry which was then used for extracting building stone, and he soon became acquainted with all the workers in it and they undertook to save for him whatever specimens they might find. Not long afterwards he met another keen collector, Professor Whitlock, of Victoria College, and they quickly learned that by giving a man a small amount they would often get a beautiful specimen. Trilobites were the chief fossils they sought for and they obtained many fine ones, some four inches long.

Mr. Elvins was able to interest several others in the study of the rocks and they formed a Mechanics' Institute, in which was a

geological museum. The organization received much assistance from the professors in Victoria College, especially Dr. Nelles, Professor Whitlock and Dr. Ormiston.[2] The last-named lectured on "Compensations in Nature," "Professor Whitlock on "The Gyroscope and its Teachings," and, in addition, there were lectures on literary subjects. At about this time Mr. Elvins met the poet Alexander MacLachlan, and they remained friends until the death of the latter in 1896.

After residing fourteen years in Cobourg Mr. Elvins moved to Port Hope, where he lived in 1858 and 1859. As before, he gathered about him some kindred spirits and they formed a scientific society. At first they met in the public school, the headmaster of which was W. S. Spotton,[3] father of Dr. H. B. Spotton, who recently resigned his position as inspector of high schools, and who is the author of a widely-used text-book on botany. Mr. Spotton frequently acted as chairman. Later the meetings were held in a public hall. At this time Mr. Elvins had made no special study of astronomy.

In 1860 Mr. Elvins removed to Toronto, then a city with a population of 44,000, and it was not long before he had gathered about him a few friends with like scientific tastes. He was employed as chief cutter in the Mammoth House, a well-known tailoring and clothing store. It was situated on King Street, opposite St. Lawrence Hall. The Mammoth House, the Golden Lion and the Golden Griffin, all on King Street within a city block, were three famous Toronto mercantile establishments of the writer's boyhood.

[2]Samuel S. Nelles was President, and also Professor of Metaphysics and Ethics, from 1850 until his death in 1887. George C. Whitlock was Professor of Chemistry, 1856-64. William Ormiston graduated in 1848 and at once was made Professor of Mental Philosophy. In 1853 he was appointed Second Master in the newly-established Normal School at Toronto and held this position until 1857. Afterwards he was a minister in the Presbyterian Church in Hamilton and in New York. He died Mar. 19, 1899.

[3]Mr. Spotton was afterwards for many years principal of the Victoria Street School in Toronto.

On coming to Toronto, Mr. Elvins was still owing on a house he had bought in Cobourg. The holder of the mortgage, Dr. John Beatty, a professor in the College,[4] that same year was moving to Ottawa, and he wished to have the mortgage cleared off. Not knowing how else to raise the money, Mr. Elvins brought his fossils to Toronto and exposed them for sale in an auction room. It was like parting with his life-blood, but they were sold and the debt was wiped off. Some time afterwards there was a loan exhibition of a number of curiosities in the music hall of the Mechanics' Institute, which was in the building at the corner of Church and Adelaide Streets, afterwards occupied by the Public Library. Mr. Elvins went to see the things, and was surprised to find amongst them many of the fossils which he had taken from the rocks. He then learned that their owner was Mr. Checkley[5] of Upper Canada College, and though Mr. Elvins offered to buy back some of them, he could not regain them.

Being engrossed with business all day, Mr. Elvins turned to studies suited to the night, and so chose astronomy. Finding out the library of the Canadian Institute, in the upper story of a building on Toronto Street, he read widely in it. During the American civil war he came in contact with Daniel K. Winder, who was an enthusiastic student of science. He had been a professor in an Ohio college (at or near Cleveland), but was a pacifist, being opposed to war under all circumstances, and also holding the view that the Bible tolerated slavery. Consequently he found it very uncomfortable in Ohio and so came to Toronto, where he settled and obtained a living as a printer. He also preached for the Disciples, but as there were very few of that religious belief in Canada, they could not employ a regular preacher. Mr. Winder

[4]John Beatty was Professor of Natural Science and Chemistry, 1845-56.

[5]Francis Lambert Checkley, Mathematical Master, U. C. Model Grammar School, Toronto, 1859-63; Assistant Master, U. C. College, 1863-65; also taught in Sarnia and London. Born Sept. 25, 1830; died Sept. 12, 1904. The fossils collected by Mr. Elvins, as well as others collected by Mr. Checkley himself, are now in the possession of the latter's son, Mr. E. R. Checkley, of Napanee, Ont.

was a good botanist, and while on pleasant walks he made Mr. Elvins acquainted with the various species of trees, and also introduced him to the use of mushrooms. Mr. Winder was the author of a book on the mushrooms of Canada. Besides this, he was well informed in astronomy and possessed a two-inch telescope. Mr. Elvins was allowed to use this and spent many pleasant hours with it.

With one or two other friends they used to gather informally at Mr. Elvins's house, 11 St. Vincent Street, and then in 1868 they put forward a proposal to form an astronomical society. Among others, they wrote to G. T. Kingston, superintendent of the Magnetic Observatory (1855-80), and to William Hincks, Professor of Natural History in the University (1853-71), and these both opposed such action, recommending affiliation with the Canadian Institute. Nevertheless this advice was disregarded and the first astronomical society in Toronto was formed. The minutes of this society are still preserved. On December 1st a meeting was held in the Mechanics' Institute "to take into consideration the propriety of forming a society for the prosecution of astronomical science." There were present: Mungo Turnbull, Andrew Elvins, Daniel K. Winder, James L. Hughes, Samuel Clare, Robert Ridgway, Charles Potter and G. Brunt.

On motion of Mr. Elvins, seconded by Mr. Turnbull, it was resolved

That a society be formed under the name of The Toronto Astronomical Club, having for its object the aiding of each other in the pursuit of astronomical knowledge; in order to which it is proposed:

I. To meet monthly at such time and place as may be agreed upon.

II. To spend the evening somewhat as follows:

(a) Reading extracts from papers or publications of anything new or otherwise interesting, bearing on the subject of astronomy.

(b) Reading original papers connected with any department of astronomy.

(c) Examining anything new in astronomical science.

(d) Observing celestial objects if circumstances should favor our doing so.

(e) Conversation, etc.

Mr. Winder was made president and Mr. Clare secretary-treasurer. The meetings were held on the first Tuesday of every month at the houses of the members. By-laws for the Club were adopted at the first regular meeting, which was held on January 5, 1869, at Mr. Elvins's house. William Long was elected a member on March 2 and William Thompson on June 1. At the meeting on May 4 the name was changed to The Toronto Astronomical Society.[6]

The society met regularly each month and reports of its proceedings were printed in Public Opinion, an English paper. The last minutes recorded are of the meeting on December 7, 1869. Looking over the minutes, I find that on March 2 Mr. Elvins read an elaborate paper on "The Moon—its Physical Constitution and Motions." In it he tried to explain libration without adopting the notion of a uniform motion of rotation on its axis combined with an unequal motion in its orbit. "He contended that the different rate of motion between the nearer and more distant parts of the moon is the cause of libration in longitude; and that the sun's attraction changes the position of the major axis of the moon's elongated body, causing the point nearer the earth to be turned upward when the sun is above the plane of the moon's orbit, and downward when the sun is below that plane, causing libration in latitude." There was not time to finish the discussion, and an adjourned meeting was held two weeks later to consider the paper. At it (according to a note in shorthand) "the members generally took part, particularly Mr. Turnbull." Mr. Elvins enunciated his views in a long letter to the Astronomical Register in 1869, and an extended discussion on the moon's rotation ensued. He stated that earlier in life he had accepted the usual explanation, but had changed his views, and these he retained to the end of his life. The present writer more than once discussed with him the question whether the moon really rotated or not, but there was no change of attitude on either side. This is not the only case in which Mr. Elvins's views on matters involving

[6]For a fuller account of the organization of the society and for information regarding its members, see this JOURNAL, **11**, 47, 1917.

celestial mechanics were not in accordance with those ordinarily held by authorities in that domain, and it was due, I think, to his lack of training in the fundamental principles of that difficult subject. As another illustration, I might refer to a theory regarding the origin of comets, which, with disarming modesty, he propounded in the Astronomical Register in 1868. This also gave rise to an admirably conducted discussion, which, however, was not decisive in favor of the theory.

The other papers presented by Mr. Elvins during the year exhibited his enthusiasm and activity as an observer. He reported that after attentive scrutiny of the formations on the moon known as Messier and Messier A, he could not accept the statement that they had undergone a physical change, as some at that time contended. He also reported at length on the Zodiacal Light during the spring of 1869, on the Aurora of April 15, 1869, and on the August meteors; and along with other members of the society he observed the eclipse of the sun of August 7, 1869, the greatest obscuration of which at Toronto was 10½ twelfths. It is worthy of note that Mr. Elvins, though evidently the moving spirit in the society, held no office, but, true to his generous nature, endeavored to have the honors go to the others.

As has been stated, the last record is dated December 7, 1869. Soon after this Mr. Winder returned to the United States, Mr. Clare's evenings were occupied in teaching, and the press of business combined to cause the work to languish. But the meetings were never entirely discontinued. Though the light often burned low, Mr. Elvins never allowed it to be extinguished. At one time the name Recreative Science Association was assumed.[7] Mr. Elvins used to recall a lecture which he heard about this time which afforded him especial pleasure. It was given by George

[7]On sheets of paper pasted in some numbers of *Popular Science Monthly* for 1872 the names of the members are given, in Mr. Elvins's handwriting, as follows: Dr. Brodie, Mr. W. Brodie, Dr. Cowdry, Mr. J. Cowdry, Prof. Ramsay Wright, Messrs. Pursey, Schnabel, Chub, Turnbull, Roberts, Foster, Carkeek, Elvins, Snarr, Armstrong, Marran, Best, Mosie. The magazine circulated amongst them.

Jennings Hinde, then a young man on the University staff.[8] It dealt with the geological features of the Scarboro' cliffs, and Mr. Elvins was able to utilize the information gained when on his trips of exploration. In 1882 he met Mr. A. F. Miller,[9] an enthusiastic and able astronomer, and somewhat later Mr. Miller introduced Mr. George E. Lumsden into the circle. Informal scientific meetings were held at various houses, but there was no fixed organization. Mr. Lumsden was Assistant Provincial Secretary and he proposed that they seek incorporation. In this I believe he was supported by Hon. G. W. Ross, the Minister of Education. In 1890 a charter was granted to The Astronomical and Physical Society of Toronto. The society owes much to Mr. Lumsden.[10] Indeed, it was largely through his energy, ability and fine judgment that it was successfully launched upon its career. To him also is to be attributed the change of the name of the society to The Toronto Astronomical Society in 1900, and to The Royal Astronomical Society of Canada in 1903.

Mr. Elvins had always been considered president of the old society without any formal election, and it was expected that he would be president of the new one. When it was decided to secure incorporation, Mr. Elvins, Mr. Lumsden and Mr. Miller called upon Mr. Charles Carpmael, the director of the Meteorological Service, to enlist his sympathy and to ask him to be patron. Mr. Carpmael expressed a desire to become an active member and at once he was made president, with Mr. Elvins as vice-president. Mr. Carpmael was often absent from the meetings

[8]Hinde was assistant to H. Alleyne Nicholson, Professor of Natural History, 1871-74. Afterwards he was on the staff of the British Museum for many years. He died March 18, 1918. He was the first person to recognize interglacial deposits.

[9]Mr. Miller was preparing to observe the transit of Venus, which took place Dec. 6, 1882, and had sent his telescope to Foster, the optician, for some alterations. Mr. Elvins noticed the instrument there, inquired for the owner, and immediately sought him out and brought him into the little scientific company.

[10]Mr. Lumsden died on September 27, 1903, aged 56 years.

and Mr. Elvins took the chair. A little later, Mr. Carpmael became ill and decided to go to England. He wished to resign and have Mr. Elvins take his place, but the latter protested and the resignation was not accepted. Mr. Carpmael retained the position until his death, but Mr. Elvins acted as presiding officer. Then Dr. Larratt Smith was elected president, and thus it came about that Mr. Elvins was never formally made president of the society. In 1893, at the age of 70, life membership was conferred upon him, on which occasion the members vied with each other in expressing their high appreciation of his scientific attainments and helpful nature. For many years he was a constant attendant at the meetings and usually had an appropriate remark on the various subjects up for discussion, especially when they related to observations reported to have been made. During the last three or four years increasing infirmity prevented him from going out in the evenings, but he continued to take an active interest in the work of the society. Indeed, just three days before his death, the present writer received a telephone message from him inquiring when the next JOURNAL would be ready.

II.

Mr. Elvins's first telescope had an aperture of 1⅝ inches and this he used for two years. Then he sent to England and obtained a 3-inch objective and an eyepiece, which were made into a telescope in Toronto. With this instrument he made many observations, especially of the sun, moon and planets; and with their surfaces and behavior he became very familiar. He was a keen observer and could give a precise and interesting account of what he saw. His drawings were very creditable, though not as finished and artistic productions as those of Keeler, Barnard and some others whose names might be mentioned. And yet he said his eyesight was not of the best, as he could never see more than six stars in the Pleiades.

He was also a persistent observer of the aurora. Indeed, within a year of his death he reported observations on one detected at 6.30 a.m. from his bedroom window. In 1869 Mr. Elvins

sent to Prof. Elias Loomis, of Yale College, notices of the auroras of April 15 and May 3 and of a 'day' aurora. Under date June 14, Loomis wrote, stating that the editor of the American Journal of Science was preparing an article on the aurora of April 15 and would incorporate in it the observations sent. He also stated that day auroras had been reported before and were referred to in the Report of the Smithsonian Institution for 1865.

Mr. Elvins had the true philosophical mind and sought to penetrate below the surface phenomena which he saw and to discover their inner causes. Knowing the relations which had been shown to exist between sunspots, terrestrial magnetism and auroral displays, he set out to correlate the phenomena of sunspots with meteorological effects, such as temperature, rainfall, barometric pressure and storms. He began with rainfall. The records of rainfall at the Meteorological Observatory at Toronto were available from 1840, and on plotting the annual precipitation in a curve he was somewhat disappointed that it did not exhibit a similarity to the sunspot curve such as had been shown to exist between the curves of sunspots and magnetic disturbances. On closer examination, however, he did discover a connection, namely, that there was a dry season both at maximum and at minimum of sunspots and that a wet season always preceded it. From the harbor master at Toronto he obtained a record of the annual mean height of Lake Ontario from 1854 to 1870, and this confirmed his conclusion. In 1870 he published in The Toronto Leader a series of twelve letters on the Meteorology of Toronto, in which he discussed the relation of solar conditions to terrestrial weather and gave the results which he had reached. Also, in the Astronomical Register for 1872, he contributed three letters in which his investigations were described; and in various quarters his work was favorably commented upon. In Nature for December 12, 1872, appeared a paper by Sir Norman Lockyer, its editor, on The Meteorology of the Future, in which problems quite similar were discussed, but without the slightest reference to Mr. Elvins's work. Mr. Elvins and some of his friends thought it unfair that he should be thus ignored.

But he was anxious to obtain means for testing his conclusions, and he sought far and wide for records of rainfall. It occurred to him that the heights of the water in a river would supply the necessary material and of all rivers the Nile would be the best, as it had been closely observed for centuries. In endeavoring to secure the information, he carried on a wide correspondence. Copies of the letters sent by Mr. Elvins are usually not available, but some of the replies are still preserved and are interesting reading. I take the liberty of giving some of them:

FROM COMMANDER E. D. ASHE

OBSERVATORY, QUEBEC,
March 16, '71.

My dear Sir:

I now enclose an account of the rainfall for as many years as I have registered it.

Since writing my paper I have been a close student of the sun and I must say that in 'Celestial Photography' I am in the first class. Some negatives that I have sent to the Astronomer Royal have been acknowledged to be far superior to anything that they can produce in England. I have some bautiful negatives of that September (1870) group. (6¼ inches in diameter is the size of the sun.) In comparing your drawings with them I see a very fair copy, but to study the beautiful definition in the negatives is a great treat, which I can do at my leisure.

My theory is this, viz.: that the photosphere is a liquid glowing mass of metal; that around the sun are meteor-planets, that revolve in orbits inclined from 15° to 40° to the sun's equator, that the disturbing forces of the earth, Venus and Mercury, draw the asteroids upon the sun in passing their perihelia, and as no meteor can be in perihelion when passing the sun's equator, we have a reason why the equatorial region of the sun is free from spots, and again because the inclination of their orbits does not exceed 40°, we have a reason why the polar region is also free from spots. As the meteor planets would fall on the sun when at P. or N. [referring to a figure], there would be two belts of spots.

But what I think fatal to your theory is, that no one can imagine that the spots can have *more* effect on the climate of Ontario than in Australia, and as no law connects the *whole world* in a meteorological sense, then I cannot see why one part is to be more affected than another. Depend upon it, there is a *combination* of events quite independent of solar spots that produces dry and wet weather. However, I am only too glad to see any

one trying to solve that difficult question, and everyone who fairly gives his ideas on any subject without "trimming his sails" to the opinion of *big men* will do science a service. I read a paper on "Solar Spots" at the Astronomical Society when in London, and De la Rue was in the chair, and because my opinions were quite opposed to his he said that 'Commander Ashe' was not up in the literature of the sun. That was five years ago, but now I can tell him that these five years' close study have confirmed my ideas, whilst *they* are obliged to *stagger* and get into all sorts of difficulties and contridictions to account for the several phenomena, whilst *our* views explain *everything*. If the Government will only give me money, I have material enough to bring before the public with my beautiful photographs. My equatorial is an eight-inch, 9 feet focus, by Clark, of Boston. I can tell when we will have a maximum of spots by looking at the position of the planets. My friend Balfour Stewart and I have had some correspondence, but unfortunately he has been hurt by a railway accident. Those who hold the "cavernous" view of spots are on their last legs.

I am anxious to hear more accounts of the last eclipse of the sun, because the negatives that I took at Jefferson, Iowa, in 1869, show detail that was not to be seen on those of any other party, *consequently* they declare that my telescope *moved*.

Let me know the size of your glass, and if you are able to give *much time* to astronomical pursuits.

I am, very truly yours,

(Signed) E. D. ASHE,

Commander (retired).

[Enclosed was a statement of the rainfall registered at the Citadel Observatory, Quebec, for the years 1861-1870.]

FROM THE SAME

April 2nd, 1871,
QUEBEC.

My dear Sir:

I send by express one of my negatives. I need not say that it is a valuable present, for one that I sent to England was acknowledged to be far superior to anything they had seen, and *no doubt* I stand at the *top* in celestial photography, the climate of Quebec is so well suited for it, but notwithstanding that I have shown the letters of the Astronomer Royal, stating how important a part photography is to take in astronomy, and how successful I have been, still the Government will not build me an observatory, so that I have to manage in a very rough way. As we have a first class "Magnetic Observatory" in Toronto, so I want a first rate astronomical observatory to be established in Quebec; but unless there is *outside*

pressure brought to bear by the papers on the advantages of such an establishment I fear that they will not do anything.

The solar negatives are too faint to print from, but if you have your negative framed it will be a great ornament to the drawing room table.

I am at a loss to know what is your business that requires your attendance from 7 a.m. to 7 p.m.

Hoping that the negative will arrive all right,

I am, faithfully yours,

(Signed) E. D. Ashe.

On June 7, 1872, Mr. Elvins wrote to the Smithsonian Institution, Washington, enclosing a rain-curve and asking for their records of rain-fall. This was answered by Joseph Henry, the secretary, on June 19, and the information was promised. In the autumn Mr. Elvins wrote again, and it may be interesting to quote in full the reply:

FROM PROFESSOR JOSEPH HENRY

Smithsonian Institution,
Washington, Oct. 22nd, 1872.

Dear Sir,

Please accept our thanks for your interesting paper in regard to rain-fall and sun spots.

Inasmuch as the influence of the sun must simultaneously affect all parts of the earth, it will be necessary, in order to ascertain whether any relation exists between sun spots and rain, that the amount of the latter be obtained from all parts of the earth. To this end the annual fluctuation of rivers would be a valuable contribution.

We have just received from General Stone, formerly of the American Army, but now in a high position in Egypt, a diagram of the fluctuation of the Nile for the last five years. In examining authorities on the subject, we find that for the last twenty-five years very accurate observations have been made as to the daily heights of the waters of the Nile, and that in the great book of Napoleon there are records at intervals, the longest of which is sixty-five years, giving the maximum of the elevation for each year. I find no definite reference to the long period you mention.

Truly yours,

(Signed) Joseph Henry, Secretary.

Andrew Elvins,
Toronto, Canada.

In 1871, Mr. Elvins sent some of his printed papers to C.

Piazzi Smyth, Astronomer Royal for Scotland, who had also been engaged on the problem of correlating solar conditions and terrestrial meteorology. I quote a portion of the reply:

FROM PROFESSOR PIAZZI SMYTH

ROYAL OBSERVATORY,
EDINBURGH, 19th May, 1871.

Dear Sir,

Many thanks for your letter of May 1, also for the 12 printed letters. I have read them all through and find them admirably clear, effective and right-minded. Perhaps I liked the earlier ones best. The various affairs were admirably treated, and the cosmical influences on terrestrial climates admirably begun..... In my temperature curves, 1830 to 1870, I find a cold period both at maximum and at minimum of sun spots, and a hot period between min. and max., but not between max. and min., of sun spots.....

Yours very truly,
(Signed) C. PIAZZI SMYTH.

In the course of his Report to the Board of Visitors for 1871, Professor Smyth makes the following graceful remark regarding Mr. Elvins's work:

More recently still a skilful Canadian writer, basing on the returns of the Toronto Observatory for many years past, considers that he has established a connection between the amount of annual rainfall there and the sun spots.

Another investigator in this domain was Cleveland Abbe, Director of the Cincinnati Observatory and Meteorologist to the Signal Office, afterwards editor for the U. S. Weather Bureau, who believed that he had established a relation between sun spots and earth temperatures. With him Mr. Elvins carried on an intermittent correspondence beginning in 1871.

Mr. Elvins realized, of course, that the discovery of a relation between sun spots and the rainfall at Toronto did not completely solve the problem; but he believed that there was a connection between the rainfall at any station and the condition of the sun's surface, and he was anxious to proceed as far as possible in the great research. As we all know, there is much still to do before

the solution will be considered ended, and some of the relations sought for are certainly obscure. But all must admire the excellent work done by Mr. Elvins, and the true scientific spirit in which he pursued it.

From the first of the above-quoted letters it will be seen that Mr. Ashe rejected the so-called 'cavernous' theory of sun spots, which was first explicitly stated by Wilson (1774), and afterwards developed in detail by W. Herschel, and favored the view that the spots were due to the descent upon the sun of meteoric matter. Mr. Elvins also supported this theory and discussed it at some length in one of a series of papers published in The Canadian Magazine, a periodical which was edited by his friend Ridgway, and which lived only seven months, July, 1871, to Jan., 1872. There were six papers in all and they bore the general title, "The Sun and the Worlds around Him." The first three dealt with the appearance and constitution of the sun; the next two, with the connection between sun spots and terrestrial phenomena; and the last one, with Mercury, Venus and the earth. They showed a good knowledge of the scientific literature on the subject and were written in a clear and pleasing style. The papers were printed under the pen-name "Omicron", and Mr. Elvins informed the present writer that he did not use his own name for fear his employers would complain that he was not giving his undivided attention to the business, although it would appear, from Mr. Ashe's second letter, that he devoted twelve hours a day!

As I have said, Mr. Elvins favored the view that sun spots were caused by the deposition of meteoric matter on the sun, but he was not satisfied with a simple vague statement of the theory. He wished to give it definiteness, so as to be able to secure evidence either to support or to disprove it.

Now, in 1863, Carrington had published his famous work on sunspots in which, amongst other results, he proved that the spots have a proper motion in a direction opposite to the direction of rotation, and that the spots near the pole are longer visible on the sun's disc during a rotation than those near the equator; and in 1867 Adams had deduced the orbit of the November meteors, with

a period of about 33¼ years; also it had been shown that the mean interval between sunspot maxima was about 11 1/9 years.

Mr. Elvins thought he could obtain from Carrington information which would decide whether his theory was valid or not, so on June 24, 1870, he addressed to him a long and well composed letter, a copy of which has been preserved. He asked Carrington to answer the following question:

> Does the rate of the proper motion of sunspots remain unchanged, from the time when they first appear, to the time when they cease to be visible? Some spots have been seen for a long time, during which the sun has made several rotations; in such cases have not the spots passed over the sun's disc in less time during the latter part of the spot's existence than during the former part?

Then, after reviewing several theories put forward to explain the production of the spots and their peculiar motions, he gives his theory, that they are due

> to meteors revolving in a large elliptical ring having the sun in one of its foci, with the aphelion beyond the orbit of Uranus; having three portions more densely crowded together than the intervening parts, and revolving in about 33¼ years; that this ring is composed in part of our November meteors, and that the November meteoric orbit is in fact the orbit in which the meteors move which cause sun-spots, but that it is comparatively a narrow, flat ring, like Saturn's, and contains meteors of every size, from the very smallest to the largest meteorites; and these are precipitated on the sun by the disturbing influence of the planets. This theory meets every difficulty and explains all the facts.

He then elaborates the theory, and he thinks that if the spots are due to the falling of meteorites, these meteorites should lose their momentum as time went on, and so the proper motion of the spots during any rotation should be less than during a preceding one.

Carrington's reply is dated at Churt, near Farnham, 1870, July 25, and he quotes the cases of eleven spots seen during three rotations, from which it appears that there were about as many cases of increase as of decrease of velocity. Thus this evidence was unfavorable to Mr. Elvins's theory.

At the present time the meteoric theory has been pretty

definitely rejected, and so also has been the 'cavernous' view as originally stated. From investigations with the spectroheliograph, it would appear that there is a hollow, but it may be in a distinct table-land on the sun's surface, and the depression is masked by overhanging clouds.

In addition, there was interesting correspondence with W. T. Lynn, of the Greenwich Observatory, on the period of the November meteors and of sunspots; with W. H. Pickering, on the moon; with Daniel Kirkwood, for many years his friend, on rain-fall statistics and other matters; with T. J. J. See, on the capture theory of comets and on the moon's motion; and with others. Dr. See, under date March 20, 1910, writes: "I have already adopted your suggestion about streams of dust interfering with the motion of the moon. This must produce *some* effect, and it may explain the outstanding difficulty." These letters exhibit the activity of Mr. Elvins's mind, which was full of hypotheses and was always seeking to correlate and explain natural phenomena.

In 1872-3 Mr. Elvins published in The Toronto Leader a series of letters on the "Origin of the Solar System". He could not accept the Laplacian nebular hypothesis in its ordinary form, chiefly on geological grounds. As usual, the letters were written in a flowing, lucid style and exhibited wide reading and much thought. He elaborated a theory in which the successive steps are: "The sun throws off *rings*; rings form *worlds;* worlds move outward from the sun; they increase in temperature; they throw off rings which form satellites; these move outward until the force of their primaries is overpowered by opposing forces; they take new orbits, long ellipses, pass round the sun as meteors and comets, and finally fall into the sun again". Though carefully reasoned out, I believe the theory dynamically unsound and the conclusions invalid. No satisfactory substitute for the Laplacian theory has yet been found.

In 1874 Mr. Elvins had another series of letters in The Toronto Leader. Professor J. M. Hirschfelder[11] had delivered,

[11] Jacob M. Hirschfelder was Professor of Oriental Languages from 1847 to 1888, first in King's College and then in University College, into which it was changed. He died in 1892, aged 83 years.

and then published, two lectures on the Mosaic account of the Creation, in which he followed the early historical treatment, and placed the creation of man at 4000 B.C. Mr. Elvins undertook to disprove Professor Hirschfelder's views from geological evidence as to the antiquity of man. There were six letters from Mr. Elvins and two from Professor Hirschfelder. Mr. Elvins's arguments were stated in the straightforward and simple manner of one who is anxious to exhibit the truth and to clear away any difficulties which may exist. He certainly had the better of the argument. I think he rather enjoyed a newspaper discussion of a scientific subject and he had many apt and neatly turned expressions. I might quote the following sentences from one of these letters:

> I am sorry to see some expressions which seem quite uncalled for, and to notice a spirit of bitterness towards myself showing occasionally. This is not needed in honest discussion: those who seek truth can afford to treat each other with kindness.
>
> * * * * * *
>
> The Professor would wish your readers to think that I am dreaming also. I assure them, on the other hand, that I speak only the words of truth and soberness.
>
> * * * * * *
>
> The Professor evidently does not regard the proof of man's antiquity which I have advanced as decisive; evidence of a different kind is at hand, equally important and far more interesting; let him "have patience and I will pay him all."

It was a great pleasure to him to meet any one who was devoted to the study of science, and he would discourse on his favorite geological or astronomical observations and theories at any length. In one of his letters he says: "I regard every student of nature as my personal friend."

I think, however, Mr. Elvins's connection with the discovery of Jupiter's fifth satellite is the most interesting episode in his scientific life. In one of his letters on the "Origin of the Solar System", dated January 4, 1873, he says:

> Jupiter is far removed from the sun, when compared with the earth, and if our theory be correct, we should find him lighter, hotter, and pos-

sessing a more dense and extensive atmosphere than the inner planets. Now, this is just what we find to be the fact in his case..... I have often watched the deeply shaded disc of Jupiter, his bright and dark belts, indicating a very extensive atmosphere, his rapid rotation and spheroidal figure giving the planet an oval shape, all seeming to indicate that the time is approaching when Jupiter will throw off its equatorial belt, and become, like Saturn, a ringed world.

The Great Red Spot was discovered in 1878, and it was studied assiduously by Mr. Elvins. At the meeting of the Astronomical and Physical Society on March 10, 1891, he read a paper on the Great Red Spot of Jupiter, of which the following is the printed summary[12]:

Mr. Elvins alluded to its appearance as a conspicuous object about ten years ago, and laid on the table drawings made by him at that time. The swift movement of the spot across the disc showed strikingly the rapid rate of the planet's rotation. The dark belt between the spot and the equator seemed to be driven from the spot by some repulsive force. Observation showed that white spots on the belts cross the disc in somewhat less time than the red spot does; the same is true of the belts themselves. Mr. Elvins suspects that the matter composing the red spot is above the atmosphere of Jupiter, and detached from it; if so, it would come under the operation of Kepler's laws, and would revolve slower than the planet rotates. He suggested the possibility of this being the first state of the existence of a satellite as yet but slightly condensed—a new satellite, in fact, in which case it would pass outside of the planet's disc; but evidence of this he had not been able to perceive. The spot ought to cast a shadow in transit. He thought the spot should be carefully observed for the purpose of ascertaining whether it can be detected beyond the disc, and of catching the shadow, if one exists.

At the meeting of the Society on October 4, 1892, Mr. Elvins made the following statement[13]:

In the Transactions of this Society for the year 1891, there was published an abstract of a paper of mine upon the Great Red Spot on Jupiter. In the course of that paper, I expressed the opinion that the planet is continually throwing off matter, which, by mutual attraction, forms solid masses, and I suggested that the Red Spot might be a mass of gaseous and

[12] Transactions of the Astronomical and Physical Society of Toronto for 1891, p. 4.

[13] Transactions of A. and P. Society for 1892, p. 67.

solid matter thus thrown off, and that it might be the first stage of the development of a satellite. Some correspondence with observers followed this paper, and, among others, I called the attention of Professor Barnard to my theory, my hope being that he would, in the course of his observations, look for such satellites. I received from the professor a reply, dated the 2nd of January, 1892. On the 11th September, as we all know, Professor Barnard discovered a fifth moon to Jupiter. I am sorry the professor has not made some reference to my letter to him, for, though the red spot is not the satellite found by him, I have reason for supposing that my letter induced him to institute a more careful search than otherwise might have been made for Jovian Satellites, which, I have no doubt, exist.

Now, Mr. Elvins's prediction arose from a theory which had but a slender physical basis and, as he himself remarks, the satellite discovered was not thrown off from the Great Red Spot; yet it must be acknowledged that his speculation was a remarkable one and its apparent verification was indeed striking. One cannot read the history of discovery without occasionally harboring the suggestion that some men are so close to nature that they develop a sort of affectionate intuition into its mysteries, and an association with Mr. Elvins for twenty-five years has more than once caused such a thought to pass through my mind.

Though Mr. Elvins felt that he had been somewhat slighted, and that his name deserved to be connected with the discovery, he did not hesitate to send his hearty congratulations to Professor Barnard. Indeed, an achievement in science by a friend gave Mr. Elvins almost as much pleasure as if it had been his own work.

Farther on in the paper last quoted from, Mr. Elvins makes another prediction regarding a satellite between V and I, basing it on a relation between the periods of the Jovian satellites somewhat similar to Bode's Law. Arranging the periods in order, they are: 12, 42½, 85¼, 172, 402 hours, which are roughly proportional to 1, 4, 8, 16, 32, a series in which 2, the second term, is missing. He predicted that a satellite exists with period about 21 hours and distance 166,000 miles. There has been no 'happy' verification of this, though four satellites much farther out have since been discovered.

III.

On rising to speak on any subject, Mr. Elvins would usually begin with a deliberation which often made the stranger fear that a wearisome disquisition was coming, but by the end of the second sentence all such fear would vanish. One could not but be charmed with his naturally choice diction, and though the words might not come quickly, the proper one always appeared at the right time. His language was always appropriate and pleasing, and through it all breathed a kindly spirit.

He loved to converse with his friends, and he was a most interesting companion. He might pass a few personal remarks, but soon one felt that trivial matters had little interest for him. He would discourse on his favorite scientific topics or on interesting incidents in his long life, or on other serious questions of the day.

The deep religious impressions of his youth were never effaced, but his views on the gravest problems of life suffered profound modifications. The most active period of his mature mind was during that time of religious unrest when the fires of criticism were fanned by the writings of Huxley, Darwin and others. With the writings of these and other contemporary thinkers he was well acquainted, and much of the traditional faith of his early years was discarded. To the present writer he remarked that he thought every person was naturally religious; but he was deeply so. He found difficulty in building a logical structure of religious belief and so he simply lived the gospel of love and service. His wife predeceased him by exactly twenty-two years. Soon after her death a monument to the poet Burns was erected in the Allan Gardens, Toronto, and on this occasion Mr. Elvins put some of his thoughts in verse, in which he referred to the loss of Burns's 'Mary' and his own 'Alice'. This composition came under the eye of his old friend, David Boyle, who had it printed in The Scottish Canadian. I quote the last four stanzas, as they clearly show how the scientist tried to resolve the mystery of the hereafter:

That energy continues seems so certain
That there are few who doubt a truth so plain;
And though we cannot see beyond the curtain
Which hides the future,—something must remain.

All energy continues; that of Spirit,
As well as that of matter, cannot cease;
And that the spirit also, must inherit,
A deathless essence,—should afford us peace.

Yes, we may rest, for surely God remaineth;
He knows what's best, and from His throne above
He lights us, guides us, and His hand sustaineth
The whole creation; we can trust His love.

Nature is moving onward,—is evolving;
And there will surely come a brighter day;
When things which puzzle will not need resolving,
For sorrow, pain and doubt must pass away.

Mr. Elvins's health was never very robust and some fifty years ago he was not considered a first class risk by a life insurance company. He had several serious illnesses, but the way in which he had ordered his life carried him through them all. For a considerable number of years he had found a happy home with his grand-daughter, Mrs. W. A. Clarke, in Toronto, and for several summers the family had lived near the lake, in the eastern portion of the city. During the last season his health had been comparatively good. Towards the end of October, however, some bronchitis appeared, but it caused no serious misgivings. On Sunday, the 27th, he was in his bed much of the time, but yet was able to get up. He expressed a desire to converse with one of his friends, Mr. Z. M. Collins, and, in answer to a telephone call, the latter came to see him. Mr. Elvins talked chiefly on religious matters. When about to leave, Mr. Collins remarked: "The war is still going on." "Yes," was the reply, "it is the greatest curse this world has. I suppose there always will be war until Messiah comes. When Messiah comes the kingdoms of this world will become the kingdoms of our Lord and of His Christ."

At midnight a visit to his room showed him to be resting quietly, but on inquiring at 6 o'clock next morning it was discovered that he had passed away in his sleep.

He most lives
Who thinks most, feels the noblest, acts the best.

RECOLLECTIONS AND APPRECIATIONS OF THE LATE ANDREW ELVINS

FROM strange and small beginnings often arise unexpected endings. In the Kingdom of Nature from the small seed embedded in the ground arises the tall and stately tree. In the Kingdom of Life it is the same. William Carey, the shoemaker, became the world-wide famed missionary of the Gospel. David Livingstone, the bare-legged cotton-mill spinner, opened up Africa to the British Empire. Prophets, priests and kings of science have also come from humble and lowly origin. Carlyle, in "Sartor Resartus", has given us the philosophy of clothes. Andrew Elvins was a humble artist in cloth, but his soul was above that, for in thought he linked himself with the immortals who read the Scriptures of the Sky, and thus he rose from Nature up to Nature's God. His mind had a distinctly scientific bent, but without any technical training. I do not suppose he could solve a simple equation, and "Newton's Principia" or Mathematical Astronomy, was to him, as to many other amateur astronomers, a sealed book and a forbidden mystery. Yet, for all that, he pondered and worked and wrote on astronomical subjects with wonderful success, and with such a modesty that he shrank within himself, and with such ability that he "blushed to find it fame".

Looking through the pages of the transactions of the Royal Astronomical Society of Canada and its predecessor, I find him to be the author of many suggestive papers, and among others these appear: "Auroral Display"; "Thoughts on Radiant Matter"; "Solar Heat"; "Terrestrial Magnetism"; "Meteorology"; "Spectrum of the Lightning Flash"; "Earthquakes and Volcanic Phenomena"; "The Moon's Present Condition". The pure mathematician rather wonders at papers from this humble seeker after truth on such recondite subjects; he was not panoplied with a university degree, but just an ordinary man among men, and with

a certain definite scientific instinct he lived and pondered in a world of his own.

Carlyle has it: "Produce! produce! if it be but the pitifullest infinitesimal fraction of a product, produce it in God's name!" And Andrew Elvins produced. Nor did he hesitate to join battle with some of the foremost astronomers of the day, although he had only a Davidic sling, and it did not always result in a victory. It is death to falter, not to die—and he never faltered.

On the 28th of October, 1918, it grew late and dark with Andrew Elvins, and now the cypress blooms above the laurel.

"Twilight and evening star,
And after that the dark."

The Father gives to every man to read in the Star Book of Nature that what He has written, and to reveal what is still unread in these Manuscripts of God; and when the man has read these marvellous tales and interpreted them to his less gifted fellow-man, then the Father calls him home to read other volumes with brighter vision and clearer mind.

We are in the early days of 1919; the future is rich in promise; it is already flushed with a coming glory; the golden age is not behind us, it is before us. To read the Book and Volume of the Sky more correctly, and to see therein and on every page of it emblazoned the name of the Creator, yea, every letter of it a glistening sun, is the lesson for every man, whether amateur astronomer or not, to learn. Lalande impiously said: "I have swept the heavens, and searched the Universe, and find no God." Andrew Elvins searched his own heart as well as the firmament, and being rightly attuned, it responded to the thrilling chorus of the morning stars when they sang together and rejoiced; for Nature never says one thing and wisdom another thing.

JOHN A. PATERSON.

I first met Andrew Elvins towards the close of the summer of 1882, in the work-shop of James Foster, where the mounting for my 4-inch telescope was under construction. I had called

there to see how the work was progressing, and Mr. Elvins, who had learned that what was then regarded as a quite large instrument had been ordered by an amateur, felt so much interested that he often came into Foster's, and as it chanced on that particular day his visit, made during his noon-hour, coincided with my own. He accosted me, saying: "You are Mr. Miller, the owner of that fine telescope?" "Yes, sir; and you are Mr. ——?" "Elvins," he replied; on which we shook hands and became friends at once, for I knew of Mr. Elvins by reputation as a scientific man; in fact, had heard of him long before. He was much pleased with the new telescope, desired to be permitted to try it, and invited me to come to his house the following Tuesday evening, telling me I would meet some kindred spirits there. I willingly accepted the invitation, and found two or three present beside our host. I thought some little effort was made, because a visitor had been asked, to give an appearance of order and method to the proceedings, as there was some mention of "minutes" and so forth; but, as I found afterwards, the meetings were entirely informal and no records were kept. However, on that particular occasion Mr. Elvins read a paper on the moon, illustrated with a few slides which he showed by means of a lantern he had borrowed from some friend. I cannot recollect who were present, except Samuel G. Roberts and, I think, Garnett Meldrum, both of whom were known to me before; indeed, I had a friendly acquaintance with the latter for more than a year previously, going to his house and he returning my visits. And I had also gone to Mr. Roberts' house to see an 8-inch reflector he had constructed, and mounted in his garden, where it stood out exposed to all weathers. I need hardly say, Mr. Elvins's acquaintance with the lunar surface was quite extensive and I was much interested in the little gathering. I continued to attend the meetings, which were held fortnightly, on alternate Tuesdays. I think the arrangement has been perpetuated in the meetings of the R.A.S.C. I met in that way G. G. Pursey, David Howell, and some others. One was a Mr. Livingston, a very eccentric person, who always insisted the celestial bodies (stars and planets) should be photo-

graphed and the photographs viewed with what he termed a "mick-roscope!" Other people came at times, sometimes as many as seven or eight, and all sorts of theories were expounded, and subsequently *pounded*, complete freedom of speech being the rule. Among all the habitués, I was only impressed by Mr. Elvins, whose remarkable fund of knowledge and originality of thought seemed to me far beyond the common. He was admittedly the leader, the master mind, and seldom advanced a theory or made an assertion without having ready good evidence in support of his views. The attendance gradually fell off and sometimes Mr. Elvins and I would be alone. On one of those occasions he showed me a "spectroscope" he had contrived, with a cardboard slit and a prism cut from a glass lamp-pendant. By means of it he showed me the characteristic bright line of a sodium salt, which was the first chemical spectrum I had seen, though familiar with the subject theoretically since "grammar-school" days. I set out to make a similar contrivance, but when hunting for a better prism, had the good fortune to find a Hofmann direct vision spectroscope, which was a kind of God-send to our little scientific band (though I soon substituted very much better instruments procured from Browning, and later mounted a Rowland grating from Brashear, who was then very little known). These advancements infused some fresh life into the *cénacle* of amateur astronomers. The meetings were revived, and generally each one had something to tell of or exhibit, either in the way of drawings of the planets, etc., or optical instruments contrived on simple lines. I recollect a spectroscope made by that dear old gentleman, Mr. Roberts, which he assured us was "very good indeed, *only it did not show any lines*"; and he made finders, microscopes, etc., all of which were "good—*only*——"

When the Thompson firm (Mammoth House) wound up their business, Mr. Elvins was out of employment and doubtless underwent some hardship. The meetings at his house were discontinued—indeed, we never met there again—and for a while the little group ceased to come together. However, he soon began a small business in Yonge Street Arcade on his own account, and

his old associates made that a rallying place. Then we resumed meetings, alternating from the home of one member to another. Mr. Elvins and the rest liked to come to my house because I had the best telescope and some apparatus for experiments, in which my old friend was keenly interested. About this time we were joined by A. F. Hunter, whose science training made him a most valuable acquisition, as he had the modern ideas and could explain them clearly. The smallest experiment made successfully delighted Mr. Elvins. I remember one night he was showing the colors produced by polarized light; I suggested examination of the colored light with a spectroscope. Immediately the cause of the colors became plain, and Hunter gave us the explanation. I then reproduced the effect with common light by receiving a spectrum on a large concave mirror, in the focus of which a white image was formed, but colors appeared when an opaque bar was passed along over the spectrum—this to illustrate how we used to work away with any means we could command. One night I showed them the sodium line "reversed". Mr. Elvins was charmed and thanked me again and again. Sometimes old Mr. Turnbull would come; poor man, he had a wretched life! A little later we were joined by Mr. Lumsden and a new order of things came into existence. Mr. Carpmael accepted the presidency and incorporation was secured. From thenceforth the society, as it now exists, took the place of the older and simpler gathering. Lindsay and the Collins brethren became members, Harvey also.

Mr. Elvins was always remarkable for the clearness of his ideas and the originality of his theories. His views were based upon an atomic theory of primitive simplicity; the atoms were very minute, hard, impenetrable bodies, possessing elasticity, moving always and only in straight lines; this motion was *energy*, which, like *matter*, was eternal and must pass from one material thing to another. He held he could explain all phenomena by "moving matter". He had me make him a model with suspended balls to demonstrate his contention. He maintained it was impossible for one body to act on another from a distance *by a pull*, hence gravity must be *a pushing together* of bodies: he strongly

objected to the word "attraction". He was strong on Newton's laws of motion, but rejected his explanation of the tides. He was to some degree uncertain as to the truth of the wave-theory of light, but allowed it to stand for want of something better. He conceived the existence of light pressure long before the theory of it was promulgated, and that inclined him to revert to Newton's corpuscular theory, though he saw the difficulties of that. He insisted that when green was "produced" by superposing blue and yellow glass or pigments the wave-lengths were changed, and when I showed him with a scale spectroscope what actually happens, and he could not deny the evident conclusion, he rather sulkily allowed he had been in the wrong—unwilling to admit it because he had founded other theories on the erroneous conclusion. He insisted that precession was the cause of the ice ages and warm periods, and it was useless to tell him the contrary. He was deeply interested in the phenomena of fluorescence, phosphorescence and similar matters. He loved to observe the aurora, and managed with his home-made spectroscope to see two or three lines. He held that the aurora was caused by *matter projected from the sun* when solar activity prevailed; however, he said it was meteoric iron, that the green line he saw was the same as the green coronal line, and a line in the spectrum of the zodiacal light which he believed he had seen (probably auroral). These are a few of the views he would expound to me.

While in Yonge Street Arcade, and later when he removed to College Street, he always had at the back a collection of home-made scientific instruments and various odds and ends, which he would bring out to illustrate some theory or prove some hypothesis.

I need not state what a bright, clear mind he had or what a pleasant companion he was. He would come to my house sometimes of a night when the temperature was below zero to be shown some telescopic object, also early of a Sunday morning to see the prominences and solar spectrum as shown by a grating. He liked to come to see me in summer when my family were in the country, and would partake of such simple hospitality as I could give

(Lumsden was the same.) He would sit in my garden looking at the trees, the sunshine, the clouds, finding beauty and joy in everything. When I built my small observatory and mounted my telescope in it permanently he, of course, came to see it, and before going home he said to me: "Now you have got everything you wished for, and when that happens to a man, *he always dies.*" That was in 1892, but I am still alive (and often *kicking!*).

He was sceptical as to many matters of religious belief, such as the inspiration of the Scriptures, also much opposed to rules and regulations adopted by various religious bodies. His religion consisted in truth and kindness toward all men and all things. He characterized as abominable and foolish cruelty such actions as are recorded of the Israelite invaders of Palestine under Joshua. As to very much of the teachings of orthodox Christian bodies he would say excitedly: "I am infidel!" He admired the character and teachings of Jesus, but thought He was sometimes in error. He did not think well of Jacob, David, and other important Old Testament characters. I never heard him speak ill of anyone living; would excuse their faults on one ground or another. He was opposed to war—wanted peace at any price—thought the Quakers' principles those on which the world should be conducted.

I kept in touch with him till he gave up his business and went to live with his grand-daughter. Then I gradually lost sight of him, being also overburdened with work connected with the building and running of the new hospital, which took up all my time. So it was we ceased to come together at the last. Now I have more time, I would have been seeking to renew our old friendship —but he has gone.

A. F. Miller.

As the last living member of the original Astronomical Society of Toronto, I have much pleasure in briefly stating my recollections of the founder of the Society, the late Andrew Elvins. When I first met him he was a journeyman tailor working for a dollar a day. He was contented in his vocation, and supremely

happy in his avocation—astronomy. Even then, more than fifty years before he died, his articles on astronomy had made him known in Europe, as a scientific investigator and an original thinker.

Without the use of a great telescope or other scientific apparatus, by observations and mathematical calculations, he reached definite conclusions that enabled him to direct investigators in great observatories to specific conditions, which on at least one occasion led to the discovery of a satellite, although his suggestions were at first treated with little respect. At ninety-two, I found him still vitally interested in original astronomical investigations.

JAMES L. HUGHES.

In my youth, when astronomy had become an enthusiasm with me, an acquaintance advised me to see "old Mr. Elvins". As I had already met him in the "Mammoth House", this was not difficult, and our meeting was the beginning of a lifelong friendship.

Not only astronomy, but natural science and problems in religion, furnished subjects of many a delightful discussion and pleasurable intercourse.

Always eager to meet the beginner on his own ground, he never tired in giving help, even in the most elementary matters. His quiet, steady enthusiasm in spreading the knowledge of his favorite study did much to awaken interest in all he came in contact with, and did much, perhaps more, than the effort of any many in Canada, in laying the foundation of the society to which he was devoted.

Memories of the meetings in his house, and later, when the movement had taken definite shape in the form of a society, in the different members' homes; field days of the old Biological Section of the Canadian Institute; or looking for double stars, nebulae, and at the planets with his home-made telescope, come to me with keen pleasure. The central figure and dominating personality of them all is that of my friend.

His first efforts to enlist the help of men of scientific training in the work of the Astronomical Society were not very successful; apparently they looked askance at the efforts of a company of eager amateurs. Eventually, however, men of the highest qualifications learned to appreciate the man at his true worth, and his desire to see the organization placed on a lasting basis was gratified.

In nearly every movement or effort in human affairs, the beginnings can be identified with some outstanding personality. In the case of the Royal Astronomical Society of Canada, its beginning is clearly identified and inseparable from the personality of Andrew Elvins.

DAVID J. HOWELL.

Norval, Ont.

To Andrew Elvins the essence of life was truth. He never ceased to look for the law that links the individual truth with its larger purpose. Recognizing the unity of truth, he could never be illogical. Dwelling in the serene of high contemplation, his mind became in later life so cosmic in its interest that often he forgot the mere mundane to a degree which amused himself as much as any. He could enjoy a joke at his own expense at times. Once he appeared in the street with two hats on his head, and when his partner suggested a look into a mirror, Mr. Elvins was convulsed with merriment at his own expense.

I once met him in a church where liberal Christianity was taught. I asked him if he was a regular attendant there. To a modified affirmative, he added the statement that he never heard there any teaching repugnant to his reason. Naturally, theology had to be spacious if it was to receive a hospitable entrance to the mind of such a man.

As a mineralogist, he pursued his avocation far past middle life with the interest of a boy. Indeed, he was even then much with boys of serious mind in these pursuits. This was but an illustration of the spirit of his life. He always felt warmly the

comradeship of science and made the greatest and the least happy in his presence by giving them to realize in a subtle and almost unconscious way that the truth mattered and nothing else.

In his declining years, he seemed to lose all sense of the flight of time. The world rushed on in its mad strife, but the mind of this sage was not a dweller in the storm. He had already reached the empyrean, and when recalled by some old reminiscence, he seemed somewhat distressed lest his memory should not be able to make for us an accurate record. 'Take him for all in all, we ne'er shall see his like again'.

ALBERT D. WATSON.

MEETINGS OF THE SOCIETY

At Ottawa

The Annual Meeting of the Ottawa Centre of the Royal Astronomical Society of Canada was held on Friday, December 13th, 1918, at the Carnegie Library, Ottawa, the President, Mr. J. J. McArthur, presiding.

The reports of the Treasurer and Secretary were presented and adopted. The books showed a small credit balance, but the membership was less than the previous year on account of the transfer of four of the members to the new branch of the Society opened at Montreal.

The election of officers resulted as follows:—

President—Mr. C. A. Bigger.
Vice-President—Dr. W. Bell Dawson.
Treasurer—Mr. D. B. Nugent.
Secretary—Mr. R. M. Motherwell.
Councillors—Mr. Thos. Fawcett.
Dr. R. E. DeLury.
Mr. Albert Hawkins.

These, with the past presidents, Dr. Klotz, Dr. Plaskett, R. M. Stewart, F. A. McDiarmid, and J. J. McArthur, constitute the Executive of the Ottawa Centre of the R.A.S.C. for the year 1919.

R. M. Motherwell,
Secretary, Ottawa Centre.

At Victoria, B.C.

The Annual Meeting of the Victoria Centre was held on the 18th inst., the elected officers of 1919 being as follows:—

Hon. President—Dr. J. S. Plaskett.
President—W. S. Drewry.
Vice-President—Dr. Young.
Secretary—K. M. Chadwick.
Treasurer—J. P. Hibben.
Executive Committee—Dr. L. Houghton, J. E. Umbach, Miss Cann, Napier Denison, A. W. McCurdy, F. C. Green.
Auditor—Thomas Shotbolt.

K. M. CHADWICK,
Secretary.

AT WINNIPEG

The Annual Meeting of this Society was held December 18th. The Treasurer's report showed that there were 13 paid-up members, and a balance on hand of $45.99.

The following is a list of officers elected for the coming year:—

Honorary President—Frank Powell.
President—H. R. Kingston, M.A., Ph.D.
Vice-President—J. H. Kolb.
Secretary-Treasurer—O. T. Anderson, M.A., B.Sc.
Council—C. E. Bastin, B.A.
J. W. Harris, C.E., D.L.S.
Mrs. Howey.
Professor L. A. H. Warren, M.A., Ph.D., F.R.A.S.
G. H. Herriot, B.Sc., D.L.S.

MINUTES OF ANNUAL GENERAL MEETING

The Annual General Meeting of this Society was held in the rooms at 198 College St., at 8 p.m., January 14, 1919, the President, Mr. A. F. Miller, in the chair.

On motion by Prof. Chant, seconded by A. F. Hunter, it was resolved that the minutes of the last Annual Meeting, having been printed in the JOURNAL, be taken as read and approved.

On motion by A. F. Hunter, seconded by Mr. Jackson, it was resolved that Mr. Forster and Mr. Paul be the scrutineers to count the ballots cast for officers to be elected at the present meeting.

The General Secretary, Mr. Jackson, presented and read his Report for 1918, which, on motion by Mr. Jackson, seconded by Prof. Chant, was received and adopted.

The Report included reports from Montreal, Ottawa, Victoria and Winnipeg Centres, and a communication from Peterborough Centre. No reports of meetings held at the Guelph, Regina, Peterborough and Hamilton Centres were received.

The General Treasurer's Report for 1918 was read, and on motion by A. F. Hunter, seconded by Mr. J. R. Collins, it was received and adopted. Financial statements from Victoria, Montreal, Ottawa Centres were received and read.

The Librarian's Report for 1918 was presented, and on motion by Prof. Chant, seconded by Mr. Jackson, it was received and adopted.

The scrutineers reported that 57 proper ballots had been cast in the election for officers, and the officers elected were as follows:—

Honorary President—Otto Klotz, LL.D., D.Sc., F.R.A.S., Ottawa.

President—Allan F. Miller, Toronto.

First Vice-President—J. R. Collins, Toronto.

Second Vice-President—Wm. Bruce, J.P., Hamilton.

Secretary—W. E. W. Jackson, M.A., Toronto.

Treasurer—H. W. Barker, Toronto.

Recorder—A. F. Hunter, M.A., Toronto.

Librarian—Professor C. A. Chant, Toronto.

Curator—Robt. S. Duncan, Toronto.

Council—Sir Joseph Pope, K.C.M.G., Ottawa.
Rev. Dr. Marsh, F.R.A.S., Pickering, Ont.
Stuart Strathy, Toronto.
John Satterly, M.A., D.Sc., Toronto.
Dr. W. M. Wunder, Toronto.
S. Beatty, Ph.D., Toronto.

These, with the Past Presidents and the presiding officers of each Centre, constitute the General Council of the Society.

Past Presidents—John A. Paterson, M.A., K.C., Sir Frederic Stupart, F.R.A.S., Professor A. T. DeLury, Professor L. B. Stewart, Albert D. Watson, M.D., Toronto; J. S. Plaskett, B.A., D.Sc., Victoria, B.C.

Presiding Officers of the Centres—A. Bigger, Ottawa; J. M Williams, Hamilton; Jas. Duff, M.A., Regina, Sask.; H. R. Kingston, M.A., Winnipeg; R. R. Graham, B.A., Guelph; W. S. Drewry, Victoria, B.C.; Mgr. C. P. Choquette, M.A., Lic.-Ses., Montreal.

On motion by Prof. Chant, seconded by Mr. Jackson, it was resolved that the thanks of the Society be tendered to the Treasurer, the auditors, and the scrutineers, for their work, and that Dr. J. B. Fraser and A. F. Hunter be the auditors for 1919.

The Meeting then adjourned.

A. F. HUNTER,
Recorder.

The General Secretary's report for 1918 is as follows:—

It affords me great pleasure to present to you the following report of our work during the past year.

Interest in astronomical matters has increased considerably during the year, for which there have been several contributory causes, chief of which was the appearance of a Nova in Aquilae, and on the same day a total solar eclipse. In addition to this, there was the completion of the great 72-inch reflector at Victoria and the commencement by Dr. Plaskett of a program of work with it which, no doubt, will greatly increase the knowledge of our universe.

Particularly gratifying is the growth of the youngest member of the Royal Astronomical Society of Canada at Montreal, where the membership has increased from 14 at the inaugural meeting in May to 35 at the close of the year.

Regular meetings have been held at Toronto, Ottawa, Victoria, Winnipeg and Montreal, as their respective reports show.

No report of meetings having been held were received from Peterboro, Hamilton, Guelph and Regina.

The total membership of the Society has increased during the year from 368 to 414.

It is with feelings of the deepest sorrow that we are called upon to record the death of our esteemed ex-President, Mr. Andrew Elvins, as well as the following Honorary Fellows:—Arthur Matthew Weld Downing, M.A., D.Sc., and Clement Henry McLeod, MA.E., F.R.S.C., etc., and the following members:—Private Clarkson Robson, Mr. George Humphrey and Dr. L. G. Pearce.

Sixteen regular meetings were held in Toronto during the year. One was withdrawn on October 29th on account of the influenza epidemic. The attendance at the meetings has not been as large as formerly, but it is hoped now that the war stress is over that more will be free to come and take part in the discussions.

The following reports have been received from Montreal, Ottawa, Victoria and Winnipeg Centres.

W. E. W. JACKSON,
General Secretary.

MONTREAL CENTRE, R.A.S.C.

REPORT OF THE SECRETARY FOR 1918

The Montreal Centre was organized by the Rev. W. T. B. Crombie, M.A., B.D., on May 28, 1918. It had then a membership of 14. In the few months that have elapsed the membership has been increased to 35. Two meetings only have been held. The first on September 12th, at which Dr. Otto Klotz, of Ottawa, delivered an illustrated lecture on "The Work of the Dominion Observatory" to a very appreciative audience. The second, on December 12th, was favored with an address by the President,

Mgr. C. P. Choquette, M.A., on "The Measurement of the Distances of the Heavenly Bodies."

It was decided by the local Council to hold only quarterly meetings until the Centre was financially stronger.

The following hold office till September, 1919:—

President—Mgr. C. P. Choquette, M.A., Lic.Ses.

Vice-President—H. E. S. Asbury.

Secretary-Treasurer—Rev. W. T. B. Crombie, M.A., B.D.

Council—Geo. Sample, James Weir, B.Sc., Lt.-Col. R. Wilson, Lt.-Col. W. E. Lyman, B.A., John Corway.

W. T. B. CROMBIE,
Secretary-Treasurer.

OTTAWA CENTRE, R.A.S.C.

REPORT OF THE SECRETARY FOR 1918

Ten meetings of the Society were held during the past year, five afternoon meetings and five evening meetings. The evening meetings were held in the Carnegie Library and were as follows:

"News from the Stars." By Mr. W. E. Harper, M.A.

"The Sun." By Dr. R. E. DeLury.

"The Geodetic Survey and Alaska Boundary." By Mr. N. J. Ogilvie, D.L.S.

"Total Solar Eclipse of June 8, 1918." By Dr. C. A. Chant.

"Mother Earth and Her Seamstress." By Mr. E. A. Hodgson, M.A.

The afternoon meetings were as follows:

"The Interferometer." By Mr. E. A. Hodgson, M.A.

"Topography." By Mr. C. R. Westland, D.L.S.

"Survey Methods of the Malay States." By Mr. J. Bowie, C.E.

"Standards Building, Geodetic Survey of Canada." By Mr. F. A. McDiarmid, M.A.

"Meeting of the American Astronomical Society at Harvard, 1918." By Dr. R. E. DeLury.

"The Treatment of Discordant Observations." By Mr. R. M. Stewart, M.A.

All afternoon meetings were held in the Geodetic Survey Building.

In the fall of the present year a new branch of the Society was opened at Montreal and four of our members were transferred to there, while two members were transferred to Victoria. One member resigned, one died (Rev. J. S. Stewart) and four new members were elected, leaving a total membership of seventy-four (74).

One more member went overseas during the year, making a total of eight, and it gives me much pleasure to report that there have been no severe casualties.

The above is the report for the year 1918, all of which is respectfully submitted.

R. M. MOTHERWELL,
Secretary, Ottawa Centre.

VICTORIA CENTRE, R.A.S.C.

SECRETARY'S REPORT FOR THE YEAR 1918

The last annual meeting was held on January 25th, 1918; owing to the absence of several of the Executive of the Society, it was unavoidably held over from the usual time of December.

Owing, unfortunately, to the bann on public meetings in the cause of public health, the Society has not been able to hold any meetings since May 13th.

The following lectures were recorded on the minute book for 1918:—

Jan. 25th, 1918—"Polishing the Mirror of the New Telescope." Dr. Plaskett.
Feb. 4th, 1918—"Abnormal Weather Conditions." N. Denison.
Feb. 18th, 1918—"Work for the Amaterur Astronomer." Dr. Young.
April 2nd, 1918—"The Tides." Comr. J. B. Shenton.
April 29th, 1918—"Applied Astronomy." W. S. Drewry.
May 13th, 1918—"Coming Eclipse of the Sun." Dr. Plaskett.

At an Executive Meeting held on March 28th, Mr. McTavish resigned as Secretary and Mr. Chadwick was appointed Secretary.

Executive Meetings were also held at 1120 Government Street on May 28th, October 3rd, and December 5th.

During the year, two notable events have occurred:—

June 11th—Opening of the new telescope on Observatory Hill.

June—The appearance of a nova, the brightest discovered in centuries in the constellation of Aquila.

Membership.—There are 72 members on the roll. Thirty-eight have paid for 1918; thirteen for 1917. There are thirteen members on the Honorary List:—G. G. Aitken, M. de G. Boyd, E. H. Harrison, Capt. H. E. Jarvis, C. L. Roberts, F. C. Swannell, P. S. Bethune, A. C. B. Gray, Dr. L. H. Houghton, P. S. Langton, V. Schjelderup, F. Wollaston, T. T. White.

The members regret the death of one of their number in the person of Mr. A. Wilson.

All of which is respectfully submitted.

K. M. CHADWICK,
Secretary.

WINNIPEG CENTRE, R.A.S.C.

REPORT OF THE SECRETARY FOR 1918

Since the last Annual Meeting, Dec. 4th, 1917, the Society has held six regular meetings, as follows:—

Jan. 24th—"Constellation Groups in History and Myth," illustrated. Dr. H. R. Kingston.

Feb. 28th—"Some Methods of Locating Our Geographical Position." Prof. G. H. Herriot.

Mar. 21st—"The Eruption of Mount Katmai in Alaska," illustrated. Dr. J. W. Shipley.

April 4th—"The Earth at its Earliest Stages," illustrated. Dr. R. C. Wallace.

Dec. 18th—"Novae," illustrated. Dr. H. R. Kingston.

O. T. ANDERSON,
Secretary.

GUELPH CENTRE, R.A.S.C.

Report of the Secretary for 1918

(This report was received after the Annual Meeting, but is included for publication in the Journal.)

The local branch of the Society has not attempted to do very much, due to the war, the officers and those interested feeling that there was so much to do otherwise in connection with the war work, that it were better to not hold meetings of the Society until after the war's ending, when a determined attempt would be made to again place the local branch among the most active of the Society's connections.

In December last the local board of health placed a ban on all public meetings, due to the outbreak of influenza, and this prevented us from holding our Annual Meeting.

The result of this is that all of the old officers have been asked to serve again, and they have all consented, which will leave the position of the Society the same as last year, with the exception of the one office, that of Secretary, and Mr. J. W. Charlesworth will take this.

With the ending of the war we hope to see the interest in the local Society renewed, and trust before long that we may show a greatly increased membership, and again hold the monthly meetings that were of such general interest to us all. During the past year one of our local members, and a gentleman who took a great interest in the Society, died in action in far-off France, and the local Society records with very much regret the death of Captain E. R. Street, D.S.O., whose kindly disposition and whose great interest in all things astronomical, made him very conspicuous in the local branch of the Society, where he will be much missed. He was the only son of the late Judge Street, of Toronto, and died a very gallant death in France, leading his men to the attack.

The Treasurer's report is appended herewith.

H. Westoby,
Secretary.

REPORT OF THE LIBRARIAN FOR 1918

On account of the continuance of the war, the accessions to the library have not been as numerous as in some past years; but, with the coming of peace, wider buying will be possible. Some purchases made in France and England several months ago, and held because of the submarine menace, will be shipped as soon as the passage of freight becomes freer. The coming year our work will undoubtedly be revived and extended.

The following statistics are offered:—

Exchanges on the mailing list:	
Canada and the Empire	37
United States	52
Other countries	27
Books borrowed during the year	77
Books purchased	18
Books donated to library	1
Number of periodicals received	595

C. A. CHANT,
Librarian.

The Treasurer's Report for 1918 is as follows:—

ROYAL ASTRONOMICAL SOCIETY OF CANADA

FINANCIAL STATEMENT FOR YEAR ENDING DEC. 31, 1918

RECEIPTS

Cash in Bank, Dec. 31st, 1917	$1,197.77	
Grant from Dominion Government	1,000.00	
Grant from Province of Ontario	600.00	
Grant from City of Toronto	100.00	
Grant from University Library (for exchanges)	100.00	
Fees from Members	546.65	
Interest on Bonds and Bank Account	123.48	
Eclipse Expedition to Colorado, Rebate	20.00	
		$3,687.90

DISBURSEMENTS

Publication JOURNAL and HANDBOOK	$1,747.94	
Public Meetings	86.50	
Library (Books, etc.)	284.18	
Slides	10.00	
Stationery, Stamps and Exchange	54.35	
Salaries (Librarian and Caretaker)	355.00	
Rent of Rooms	100.00	
Grant to Ottawa Centre	95.00	
Grant to Montreal Centre	25.00	
Printing	119.60	
Insurance	13.00	
Eclipse Expedition to Colorado, Expenses	150.00	
Balance in Bank	647.33	
		$3,687.90

Respectfully submitted,

H. W. BARKER,
General Treasurer.

Audited and found correct,

A. F. HUNTER,
JNO. B. FRASER, M.D.,
Auditors.

January 14th, 1919.

MONTREAL CENTRE

FINANCIAL STATEMENT, MAY 28TH-DEC. 17TH, 1918

RECEIPTS

Interim Appropriation through General Treasurer	$ 25.00	
Fees Collected by Local Treasurer from 13 Members	26.00	
		$ 51.00

EXPENDITURES

Advertising	$ 3.75	
Janitor's Expenses	4.50	
Lantern Attendant	2.00	
Expenses of Lecturer	1.75	
Blank Books for Secretary	1.10	
Postage and Stationery	5.48	
Fees sent to General Treasurer	26.00	
		$ 44.58
Balance, Cash on Hand		6.42
		$ 51.00

Respectfully submitted,
W. T. B. CROMBIE,
Secretary-Treasurer.

OTTAWA CENTRE

FINANCIAL STATEMENT, 1918

RECEIPTS

Balance on Hand	$ 3.32	
Grant from General Treasurer	95.00	
		$ 98.32

DISBURSEMENTS

Printing	$ 42.70	
Lectures	20.00	
Postage, Cartage, etc.	10.50	
Use of Lecture Hall	6.00	
Small Items	1.51	
		$ 80.71
Balance on Hand		17.61
		$ 98.32

Respectfully submitted,
D. B. NUGENT,
Treasurer.

Examined and found correct,
(Signed) D. ROBERTSON.
Dec. 13th, 1918.

WINNIPEG CENTRE

Financial Statement, 1918

RECEIPTS

Dec. 4th, 1917—	Balance on Hand	$108.56	
	Subscription Fees of 12 Members	24.00	
	Interest	1.83	
			$134.39

EXPENDITURES

Dec. 5th, 1917—	Honorarium to Caretaker	$ 5.00	
April 3rd.	200 Official Post Cards	6.25	
April 12th.	Remittance to Toronto	24.15	
June 1st.	Grant to help defray Expenses of Representative to view Eclipse	50.00	
Dec. 16th.	Remittance to Toronto	2.00	
Dec. 16th.	Stamps, etc.	1.00	
			$ 88.40
	Balance on Hand Dec. 18th		45.99
			$134.39

Audited and found correct,
C. E. Bastin,
G. H. Herriot.
Dec. 18th, 1918.

GUELPH CENTRE

Financial Statement, 1918

Jan. 1, 1918—	Balance on hand	$ 3.72	
	Fees Received	34.00	
			$ 37.72
Jan. 15, 1918—	By Postage Stamps		1.00
	Balance in Royal Bank of Canada		$ 36.72

H. Westoby,
Treasurer.

VICTORIA CENTRE

Financial Statement, 1918

RECEIPTS

Jan. 30, 1918—Balance		$ 34.70	
Dec. 18, 1918—Dues:			
	39 for 1918	78.00	
	13 for 1917	26.00	
May 31	Bank Interest	1.01	
			$139.71

EXPENDITURES

June 6	Board of School Trustees: Use of Girls' Central Auditorium	$ 2.50	
	Colonist Printing Co.	15.15	
	Times Printing Co.	2.79	
	Postage Stamps	1.00	
Dec. 18	Balance in Bank	118.27	
			$139.71

Correct,

T. Shotbolt,

Auditor.

NOTES FROM
THE DOMINION ASTROPHYSICAL OBSERVATORY
VICTORIA, B.C.

AN INTERESTING DOUBLE

In the course of the radial velocity programme of this observatory, the star Boss 6158, R.A. 23 54.4, Dec. + 33 11 (1900), was observed. This star is a double, No. 12675, Burnham's General Catalogue, the separation of the components being now in the neighborhood of 2″. They are of equal magnitude, visual 6.58, photographic 7.08, and of the same type, about F5. Burnham plots their relative motion, which he states is "apparently rectilinear".

It seemed to me, when they are so close together in the sky and of equal magnitude and type, there is a high probability that they are physically connected. If, in addition, their radial velocities proved to be nearly the same, this probability would be greatly strengthened.

It will be of interest, as showing the actual performance of the new installation, to give the particulars of observation and measurement. Spectra of each have been obtained on five nights with the single prism form of the spectrograph, linear dispersion 35A per mm. at Hγ. The spectra are all well exposed, although the average exposure time given each star of 7.08 phot'c mag. was 19.6 minutes. The plates were measured on the Hartmann Spectro-Comparator with the following values of the velocity:

Date, 1918.	Vel'y Preceding Star.	Vel. Following Star.
Oct. 19	—5.7	—5.8
Oct. 24	—7.9	—3.0
Oct. 29	—8.6	—3.5
Nov. 24	—6.5	—5.4
Dec. 15	—8.3	—3.3
Means	—7.4	—4.2

The probable error of a single plate, so far as it means anything from so few observations, is ± 0.85 km. per second.

The difference in velocity is of the order to be expected if the star were a binary, and this, taken in conjunction with the small separation, the equality in magnitude and type, make a chain of coincidences improbable on any supposition except that the stars are physically connected.

J. S. Plaskett.

Dominion Astrophysical Observatory,
Victoria, B.C., Jan. 15, 1919.

NOTES FROM THE METEOROLOGICAL SERVICE

Summary Report of the Weather in Canada

January, 1919

Temperature– The mean temperature was above average throughout the Dominion, with the greatest departure from normal—from 18° to 20°—in Alberta and southwestern Saskatchewan. To the eastward this wide positive departure diminished gradually to between 9° and 6° in Ontario, and to about 3° in the Maritime Provinces. To the westward the decrease in positive departure was more rapid, and the interior plateaus of British Columbia were but 5° above average, and the coast line about 3° above.

Precipitation—Precipitation was very generally deficient, except near the British Columbia Coast, where there were many heavy rainstorms, and in the Gulf of St. Lawrence, where there was a very heavy snowstorm on the 24th. In Nova Scotia and Southern New Brunswick the precipitation was nearly equally divided between rain and snow. In Northern New Brunswick and Eastern Quebec it was almost wholly in the form of snow, while in Western Quebec and Southern Ontario it was quite light, and part snow and part rain. In the Western Provinces a few light snowfalls occurred in Manitoba and Saskatchewan, but over a large part of Alberta there was practically little, if any, either snow or rain. The rainfall in the Lower Mainland of British Columbia and Vancouver Island was very heavy, but in the Upper Mainland, the precipitation, mostly as snow, was not excessive.

Temperature for January, 1919

Station	January		Station	January	
	Highest	Lowest		Highest	Lowest
Yukon			Kenora	36	-34
Dawson	18	-48	Kinmount	39	-30
British Columbia			Kingston	46	-12
Atlin			Kitchener	45	- 2
Agassiz	49	20	London	48	0
Barkerville	38	0	Lucknow	41	-10
Kamloops			Markdale	41	- 5
New Westminster	50	22	North Gower	40	-24
Prince Rupert	56	24	Oshawa	44	6
Vancouver	52	24	Ottawa	40	-20
Victoria	52	33	Paris	47	- 3
Western Provinces			Parry Sound	38	-20
Battleford	45	-27	Peterboro'	43	-19
Calgary	55	6	Port Arthur	37	-22
Edmonton	47	-15	Port Burwell	46	5
Medicine Hat	58	15	Port Dover	44	1
Minnedosa	38	-36	Port Stanley	47	5
Moose Jaw	48	-31	Queensborough	39	-27
Oakbank	37	-34	Ronville	38	-28
Portage la Prairie			Southampton	46	- 1
Prince Albert	44	-34	Sundridge		
Qu'Appelle	43	-33	Stonecliffe		
Regina			Stony Creek	47	5
Saskatoon	42	-29	Toronto	47	0
Souris			Uxbridge	41	-16
Swift Current	50	-24	Wallaceburg	52	5
Winnipeg	38	-30	Welland	53	0
Ontario			White River	35	-37
Agincourt	42	- 4	*Quebec*		
Aurora	39	- 9	Brome	43	-25
Bancroft	39	-25	Father Point	34	-18
Barrie	48	- 9	Montreal	40	-15
Beatrice	37	-22	Quebec	36	-16
Bloomfield	40	5	Sherbrooke	49	-21
Brantford	47	- 2			
Chapleau			*Maritime Provinces*		
Chatham					
Clinton	40	- 1	Charlottetown	44	- 8
Collingwood			Chatham	38	-18
Cottam	50	- 1	Dalhousie		
Georgetown	42	- 5	Fredericton	38	-19
Goderich			Halifax	50	- 6
Gravenhurst	39	-20	Moncton		
Grimsby	45	3	St. John	46	-12
Guelph	42	- 3	Sussex		
Haliburton	40	-23	Sydney	50	- 4
Huntsville	39	-28	Yarmouth	50	1

Earthquake Records by the Milne Seismograph

TORONTO

Sir Frederic Stupart, Director.

P.T. = Preliminary Tremors. S. = Secondary Waves. L.W. = Large Waves. A.C. = Air Currents. Time is Greenwich Civil Mean Time, 0 or 24 h = midnight.

No.	Date 1919	P. T. Comm.	S. Comm.	L.W. Comm.	Max.	End	Max. Amp.	Remarks
		h m	h m	h m	h m	h m	mm	
1949	Jan. 1			2 10·1 2 36·8	2 56·1	Merged into next eq.	1·0	Early phases masked by micros.
1950	" 1		3 16·2	3 29·4	3 31·9	Micros.	4·0	First phases intermixed with trailers of No. 1949.
1951	" 6			23 26·6 23 30·5	23 33·2	Micros.	0·7	
1952	" 7			0 41·9 0 44·0	0 46·0	Micros.	0·4	
1953	" 8			2 03·1 2 05·4	2 08·0	Micros.	0·3	
1954	" 17			12 09·7	12 16·8	Micros.	0·2	Micros going on.
1955	" 27			21 56·1?	21 58·1?	Micros.	0·3?	Micros going on.
1956	" 31			23 48·8 23 56·9		Micros.	0·2	Micros going on.

5th. Heavy micros. masked earthquake registered at other stations.

Boom period 18 seconds. Pillar inclination 1mm. = 0°·45.

VICTORIA, B. C.

F. N. DENISON, SUPERINTENDENT.

No.	Date 1919	P.T. Comm.	S. Comm.	L.W. Comm.	Max.	End	Max. Amp.	Remarks
		h m s	h m s	h m s	h m s	h m s	mm	
*1951	Jan. 1	1 47 32	1 57 53	2 11 50	2 41 05	?	1·4	9220 km. F lost in next quake.
1952	" 1	3 11 00	3 13 19	3 17 17	3 22 44	6 05 23	6·3	1,310 km.
1953	" 5			20 39 59	20 43 25	20 51 17	0·2	
1954	" 6	22 47 55	22 53 49	23 03 40	23 16 27	0 17 28	2·0	4,120 km.
1955	" 7	0 44 28	0 47 25	0 51 21	0 59 13	1 15 57	0·3	1,710 km.
1956	" 8	2 17 08		2 21 36	2 24 34	2 41 55	0·4	
1957	" 17	12 09 07		12 10 35	12 12 04	12 22 53	2·4	660 km.
1958	" 27			21 50 47	21 58 14	22 23 01	0·2	
1959	" 31	23 45 26		23 46 55	23 47 35	0 03 47	1·0	615 km.

*Change in numbering due to omission of small quake of November 2nd which should be No. 1924.

Boom period 18 seconds. Pillar inclination 1mm. = 0″·54

VERTICAL SEISMOGRAPH

Date 1919	P.T. Comm.	S. Comm.	L.W. Comm.	Max.	End	Max. Amp.	Remarks
	h m s	h m s	h m s	h m s	h m s	μ	
Jan. 1	3 11 12	3 13 04	?	3 26 00	?	143	1,040 km.
" 6			23 06 00	23 11 00		3	
" 17	12 09 00		?	12 12 30	?	3	
" 31	23 45 12		23 46 34	23 47 20	0 00 00	6	600 km.

J. Y.

MAGNETIC OBSERVATIONS

DECEMBER, 1918

During the month of December the Magnetic Forces, as recorded at Agincourt and Meanook, were generally very little disturbed. The period of greatest disturbance was from the afternoon of the 7th until the 10th. Rapid variations of both H and D of fairly large amplitudes occurred during the night of the 7th and again with lessened amplitudes during the nights of the 8th and 9th. In the Z the movements were slow but progressive and the departures from normal were quite large.

On the 25th a moderately active disturbance was recorded at Agincourt continuing all day. At Meanook in D this disturbance was particularly active from 6h. to 12h. 105th M.T.

Sunspots as recorded in Toronto were not nearly so numerous as in preceding months, yet on all days on which observations were made there were some to be seen.

There was also a marked diminution in the number of reports of the aurora by Meteorological observers. On the 7th and 8th however the aurora was observed in all parts of Canada and on the 24th and 25th in the Prairies Provinces only. No reports of aurora were made on the 15th, 19th and 28th and on the remaining days only from one to three observers report having seen it.

AGINCOURT MAGNETIC OBSERVATIONS

Lat. 43° 47′ N.; Long. 79° 16′ W.

December, 1918		D. West	H	Z	I
		° ′	γ	γ	° ′
	Mean of Month	6 39·5	15892	58324	74 45·5
	Maximum	7 18·2	16041	58454	
	Date of Maximum	25	7	25	
	Minimum	6 08·8	15653	58128	
	Date of Minimum	9	8	8	
	Monthly Range	1 09·4	388	326	
Mean Daily Amplitude	From hourly readings	6·6	34	25	
	From means of extremes	20·2	89	47	

MEANOOK MAGNETIC OBSERVATIONS

Lat. 54° 37′ N.; Long. 113° 21′ W.

December, 1918		D. East	H	Z	I
		° ′	γ	γ	° ′
	Mean of Month	27 42·9	12953	60481	77 54·7
	Maximum	29 45·8			
	Date of Maximum	8			
	Minimum	26 33·5			
	Date of Minimum	8			
	Monthly Range	3 12·3			
Mean Daily Amplitude	From hourly readings	11·0			
	From means of extremes	46·1			

H and Z are given in Gammas. (1 γ = 0·00001 C.G.S.).

All results are reduced to I.M.S.

The value of I at Meanook is the mean of all the observations made during the month without regard to the time of day.

The value of H at Meanook is the mean of two observations made about the middle of the month, and the Z is obtained by the formula Z = H tan I.

W. E. W. J.

ASTRONOMICAL NOTES

THE EVOLUTION OF BINARY SYSTEMS.— It is a fundamental fact of stellar dynamics that adjacent stars interfere to only an infinitesimal extent with one another's motion; the alterations in a star's motion must be ascribed to the gravitational forces of the universe as a whole. These latter forces can have only an infinitesimal effect on a star's angular momentum, whence it follows that the angular momentum of a star, or stellar system, must remain very approximately constant.

Assuming this constancy of angular momentum, it is well known that the angular momentum of our solar system is too small for the system to have broken up by rotation. This difficulty has been amply discussed; the present paper deals with a similar difficulty which has hardly been discussed at all, namely, that the angular momentum of the majority of binary systems is too large for them to have broken up by rotation.

At this stage only two hypotheses seem to be consistent with dynamical theory:

(A) The periods and dimensions of orbits of binary stars are permanently fixed, and have retained approximately their present values through the whole of the star's life.

(B) The periods and dimensions of orbits of binary stars, although now definitely fixed, have been determined as the result of interactions with other stars in some past epoch in which these interactions were not negligible.

Conclusion.—We have found that there is only one hypothesis which is capable of reconciling the facts of observational

astronomy with dynamical theory. It is that the present epoch in the history of our universe was preceded by one in which the stars were much more closely packed than they now are, so that stellar encounters at fairly close distances, instead of being rare events of negligible frequency, were events of comparatively common occurrence. Such encounters must have increased the eccentricities and periods of our long-period binaries to their present values; from now on the periods both of these and of the short-period binaries are likely to vary but little.

The main hypothesis, that the stars were formerly closer together than now, is not difficult to accept. If we suppose the stars to have been formed by a process of nebular condensation, it becomes almost inevitable. If the stars, with their present spacing, were redissolved into a continuous nebular mass, the mean density of this nebular would be of the order of 10^{-23} only. Now the average mass of stars formed by gravitational condensation out of a continuous nebular mass depends upon the density of the nebula, and masses comparable with those of our sun and stars would be formed out of a nebula of density of the order of 10^{-19}. The hypothesis of nebulous origin commits us to the supposition that our universe must have expanded by at least about ten diameters since its nebular stage. It is open to question whether this expansion is not still going on. The observed positive excess of radial velocities of stars of all types, particularly the 5 kms. a sec. excess velocity of the B-type stars, is most naturally interpreted as an expansion taking place now before our eyes.

We suppose the longest period binaries to have lived through sufficient of this earlier epoch for equipartition of energy to have been established, or approximately established, in their internal degree of freedom. It follows that equipartition ought also to have been established as regards their motion of translation in space. This is probably the case; the dwarf M-stars have velocities which show no preference for particular directions in space, and there seems to be no correlation between the magnitude of their velocities and the parts of the universe they occupy.

The old objection that the present spacing of the stars leads to a "time of relaxation" of the order of 10^{14} or 10^{16} years is removed by our main hypothesis.

On the other hand, the short-period binaries, which are mainly early type stars, cannot have lived through this earlier period as binary stars. The circumstance that they largely fall into undissolved moving clusters of stars having a common velocity in space leads us still further and suggests that these early type stars cannot have existed at all during the early period. We are led to regard the B type stars and short-period binaries as of more recent birth: neither in their velocity of translation nor in their internal motions do they show evidence of encounters with other stars. They are mainly still close to the galactic plane in which we must suppose them to have been born; they were perhaps the last stars to be born out of the rotating nebula which we may suppose to have been the parent of our system of stars.—J. H. JEANS, M.A., F.R.S., Monthly Notices, Royal Astronomical Society, December, 1918.

THE GEGENSCHEIN OR AFTERGLOW.—The gegenschein is always best seen in September, October and November. It is then largest and brightest.

These positions show quite clearly that the gegenschein is on the ecliptic and exactly (180°) opposite the sun. My previous observations also proved this fact. It is not probable that this condition can exist for any celestial body. It seems certain from this exact opposition to the sun that the phenomenon is in no sense a celestial one, and that its explanation must rest alone in the earth and the sun.

The more familiar one becomes with it the larger it appears. I have seen it 40°, 50° and even 60° in diameter when it would seem to fade insensibly into the night. Under these conditions it has been round and very gradually a little brighter towards the centre.

The gegenschien has always seemed to me to be due in some way to a concentration of the sun's light by refraction in the

atmosphere (opposite the sun) as if the atmosphere acted as a spherical lens. If this is so then the gegenschein has no more interest than twilight or dawn. To this theory is opposed the question of parallax. As projected on the landscape the rainbow has a great parallax but if it were seen against the stars it would have only the parallax of the sun. May not there be in some way a similar effect (though the two things must be entirely different) in the case of the gegenschien that would account for the want of any large parallax? I do not believe that any one else has ever offered this explanation. The only other theory that seems plausible from the conditions is that of a tail to the earth, a theory that was offered, I believe, by Mr. Evershed. The parallax objection holds also in this case.

Apparently there is one other drawback to the atmospheric theory of the gegenschein. I have a great many records which show that it is not always round, but sometimes seems much elongated. This apparent elongation repeats itself each year at about the same time– in the latter part of October.

The best explanation of the cause of the gegenschein from a mathematical standpoint is given in a paper by Dr. F. R. Moulton in the Astronomical Journal, Vol. **21** (1900), 17, where he shows that it may be due to the accumulation of meteoric matter some 930,000 miles outside the earth's orbit, through the attraction of the earth and moon and the sun.

While this ingenious theory could account for the gegenschein, I do not think it is the true explanation—E. E. Barnard, Popular Astronomy, February, 1919.

The Dark Markings of the Sky.—It would be unwise to assume that all the dark places shown on photographs of the sky are due to intervening opaque masses between us and the stars. In a considerable number of cases no other explanation seems possible, but some of them are doubtless only vacancies.

I do not think it necessary to urge the fact that there are obscuring masses of matter in space. This has been quite definitely proved in my former papers on this subject. If any doubt

remains of this it will perhaps be readily dispelled by a close examination of the photographs previously printed. The conclusive ones I think are :

The photograph of the nebula about Nu Scorpii which clearly shows partial and complete obscuration by the great wing-like nebula that covers much of the immediate region of Nu Scorpii and extends southward to the great nebula of Rho Ophiuchi.

The region of Rho Ophiuchi, where a large space of sky is blotted out by a great and beautiful nebula. The fact of obscuration is clearly evident here, for wherever a trace of the nebula extends, especially to the west, the general background of small stars is sharply blotted out.

To me these are all conclusive evidence that masses of obscuring matter exist in space and are readily shown on photographs with the ordinary portrait lenses. What the nature of this matter may be is quite another thing. Slipher has shown spectroscopically that the great nebula about Rho Ophiuchi is probably not gaseous ; that is, it does not have the regular spectrum of a gaseous nebula. The word "nebula" nevertheless, remains unchanged by this fact, so that we are free to speak of these objects as nebulæ. For our purpose it is immaterial whether they are gaseous or non-gaseous, as we are dealing only with the question of obscuration.

Then follows a descriptive catalogue of 175 of these objects.

This catalogue is necessarily incomplete ; it is constantly being added to. Later, a more complete list will be printed. The places are closely approximate. An effort was made to measure the positions with exactness, but on account of the nature of the objects it was found to be practical to do this in only a few cases.—E. E. BARNARD, Astrophysical Journal, January, 1919.

ATMOSPHERIC TIDES.—Sir Napier Shaw took the chair at last week's geophysical meeting at Burlington House. Dr. Wedderburn opened a discussion on seiches, or rhythmic varia-

tions in level of enclosed or partly enclosed sheets of water, first noted in the Lake of Geneva in 1730, where a variation of 5 or 6 feet was recorded. The first account of a similar phenomenon in Scotland was on November 1, 1755, when a rise and fall of 2½ ft. at five-minute intervals was observed in Loch Lomond and similar "seiches" in Loch Katrine, Loch Ness, and elsewhere, all being attributed to the Lisbon earthquake. In America as much as 14 ft. has been reported. It is now decided that even strong gales will not as a rule, cause "seiches," which may have their origin in floods or excessive rainfall or atmospheric squalls. They may also be attributed to periodic fluctuations of the barometer. Dr. Chapman afterwards spoke of the atmospheric tide. He finds that in Tropical regions the sun is responsible for a tide of one millimetre, while the moon, which in ocean tides has twice the effect of the sun, only produces an atmospheric tide 1-16th of that of the sun. This seems to suggest that the effect is not due to gravitation, and Lord Kelvin asserted that it is not a tide, unless for some reason a small effect is reinforced by a vibration of the whole atmosphere with a period nearly equal to that of the tide, or approximately twelve hours. It must be concluded that the atmospheric tide is mainly a temperature effect, especially as the solar portion of it is far more important than that of the moon.—English Mechanic and World of Science, No. 2810.

J. R. C.

NOTES AND QUERIES

Communications are Invited, Especially from Amateurs. The Editor will try to Secure Answers to Queries.

QUERY

LIFE IN OTHER WORLDS

Has it ever been stated that other heavenly bodies than this particular planet have life on them. By 'life' I do not mean just as we know the word, but is it at all likely that there may be life other than we know it?—H. H. C.

ANSWER

We possess no positive knowledge regarding the above subject, and the writer of the query has quite as good a right to her views as has any professional astronomer. Many certainly believe that there are other worlds, and on them life varying, perhaps, somewhat from our own; but the scientist has no evidence on these matters.

A GREAT LOSS TO ASTRONOMY

In the passing of Edward Charles Pickering, the United States, and indeed the world, has lost one of its most distinguished astronomers. The announcement of his death came just in time to be noticed in last month's issue. Here I shall offer a few personal remarks, and next month it is hoped to print a fuller account of the late Director's life and work, prepared by a member of his staff.

I had met Professor Pickering at several meetings of the American Astronomical Society, had also made one or two flying trips to the Observatory, and then in 1916 I made a stay there

several weeks in length. The session at the University of Toronto had closed early and I thought I could improve my time in studying the methods used at the Observatory, and also in commencing an investigation which I might afterwards complete in Toronto. The Director was very cordial in inviting me to come, and I did not have to wait many days after my arrival to discover that I had fallen among friends.

At the time of my visit Professor H. C. Wilson, the capable editor of "Popular Astronomy," was spending some months at Harvard, and my association with him and his estimable wife was a great pleasure. Of course, we did not become fully acquainted with all the expedients used in observing and computing in the Observatory. Professor Pickering had been in charge for so many years that, everywhere one went, devices which he had either suggested or encouraged were in evidence. The Harvard College Observatory has certain classes of investigations and ways of doing them which are quite its own. It was very interesting to see how some of the immense projects, involving an enormous amount of routine work, were systematized and carried out with great care, but with remarkable speed. Referring to some of the investigations which had been published in the familiar and numerous "Annals", the Director told me that, after arranging the general plan, the work was left almost entirely in the hands of the person who was to carry it out.

Two especially pleasant incidents of my stay in Cambridge, due to Professor Pickering's courtesy, were a dinner with the Round Table Club and a luncheon with the Saturday Club. The former was in the fine quarters of the Harvard Club of Boston. On my left sat Professor Cross (physics), on my right Professor Talbot (chemistry), and next to him Professor Swain (engineering), all of the "Tech." The last-named acted recently for the Canadian Government in estimating the assets of the Canadian Northern Railway. Professor G. E. Hale was also a guest at the dinner, and afterwards in the evening gave an address at the American Academy on the investigations in progress at Mt. Wilson. On expressing to Professor Swain my satisfaction with

the attitude of the United States towards the Allies, he did not hesitate to state his view that his country should help the cause of freedom by force of arms. A similar remark to Professor Hale brought out an even stronger pronouncement for immediate action. These two men, though two of the most practical of men in carrying out great undertakings, were guided by noble ideals and believed in fighting for a great principle.

As is well known, the Saturday Club has had a distinguished history, and I recall a few who were present on this occasion: Dr. C. W. Eliot, Dr. Harvey Cushing, Dr. E. W. Emerson (who has recently published a history of the Club), Prof. W. G. Farlow, E. W. Forbes, W. C. Forbes (ex-Gov. of Philippines), Judge Robert Grant, President A. L. Lowell, Dr. G. F. Moore, Moorfield Storey. Dr. Eliot, who sat at the head of the table, recounted to me some of the characteristics of former famous members, among them O. W. Holmes, H. W. Longfellow and J. R. Lowell.

I should not forget several charming drives in Professor Bailey's motor to neighboring towns rich in New England historical memories, on which occasions the Director, with a map before him, acted as navigating officer and guide.

A suggestion to Professor Pickering that we might utilize some of his accumulated material in carrying out some investigations at the University of Toronto, especially by candidates for the M.A. degree, received a ready response and a further offer to obtain, if possible, any additional material we might require. We have already been able to adopt this plan, with results of some value, and in the near future, when conditions are again nearly normal, we hope to make greater use of the generous offer.

If I should attempt to name the chief characteristic of the late Director and the Observatory staff, I would say it was *service*. Astronomers all over the world will hope that the same spirit may continue to remain there.

I was gratified to learn that Dr. Otto Klotz, Chief Astronomer, attended the funeral of Professor Pickering and acted as an honorary pall-bearer. In this way our country and our society were fittingly represented.

THE RICHARDTON METEORITE

[By TERENCE T. QUIRKE, University of Minnesota, in *Science*.]

On July 21, about 10 p.m., many people saw a meteorite fall in the district lying between Mott and Richardton, N. D. From the descriptions of many eye-witnesses it appears that the meteorite fell at a low angle, about 75° from vertical, and that its direction of flight was about due north. It seems to have burst a few thousand feet above the ground, and to have broken into many pieces, over a hunderd of which have been found. The weight of the material discovered is about 200 pounds. The meteorite is stony, poor in metallic parts, composed of little spheroids in a gray brittle matrix, classified tentatively by the writer as a veined kügelchen chondrite.

Nearly all the witnesses agree that the meteorite made a very bright light and a rushing sound, followed by a noise like thunder, and that it made the windows rattle and the houses shake; two men heard the whistle of stones like the flight of bullets, and one heard the stones rattle upon the roof of his barn, near which specimens were later found. The most intelligent witness says it looked first like a very bright falling star, and that it burst like a Roman candle, after which he heard the stones falling. Every one admits that he was very much frightened, most of them emphasize the terrifying noise and the brilliant light.

The meteorite did not fall at a very high velocity, for few pieces have been found buried in the ground, most pieces were found in pastures or wheat fields. Two pieces at least were found partly buried in loose soil. One, weighing 6¾ pounds, was found about six inches in sandy soil where it had fallen and broken into several pieces as it struck. Some pieces show secondary fusion surfaces, and some appear to show tertiary fusion surfaces. The stone is brittle and most of the pieces are broken; however, one fine boloid of twenty pounds has been found and several of about ten pounds weight.

DEATH OF TWO OLD MEMBERS

On Tuesday, February 18, George G. Pursey died at 137 Helendale Avenue at the age of eight-eight. Mr. Pursey was a close friend of the late Andrew Elvins, both being self-educated men, well versed in science and of a kindly nature. Mr. Pursey was also fond of philosophical reading, and while working at his trade revolved in his mind theories of life and of science. For many years he used to record on each bright day the state of the sun's surface as observed in a small telescope. Mr. Pursey was a charter member of the Astronomical and Physical Society when it was incorporated in 1890. He was a native of Somerset, England.

The death is also announced of Angus Sinclair, who was for some years the Society's librarian. He graduated at the University of Toronto in 1870, winning the gold medal in mathematics, and received the M.A. degree the following year. He taught for some years in the Windsor Collegiate Institute. For some years he lived in Toronto. **He died at St. Mary's, on December 29, 1918.**

C. A. C.

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